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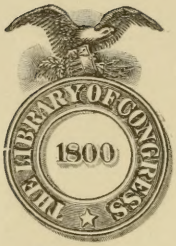
MODERN
DAIRY GUIDE

MARTIN H. MEYER



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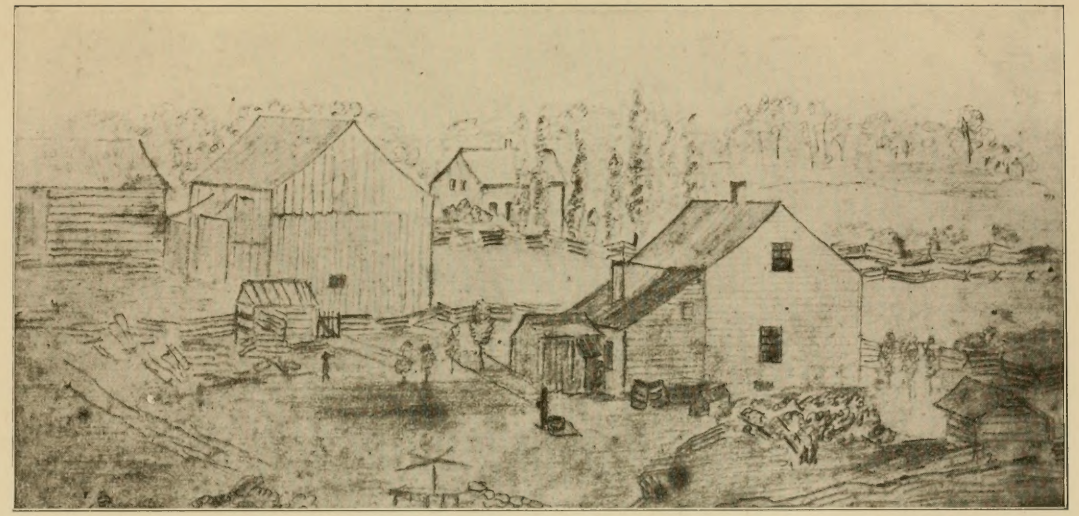
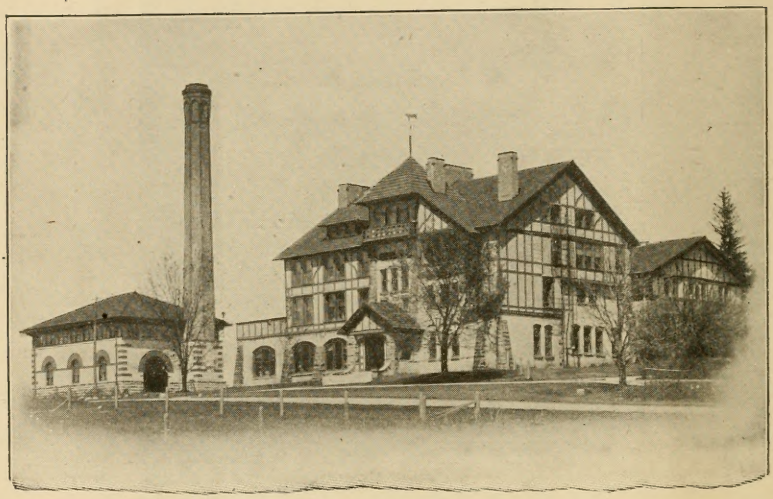


A lead pencil sketch of a pioneer log-cabin built about 1855 near Cedarburg, Wisconsin.
The birth place of the Author, Martin H. Meyer.



DAIRY SCHOOL. MADISON, WISCONSIN.

Modern Dairy Guide
TO
GREATER PROFITS

By MARTIN H. MEYER

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MADISON, WISCONSIN

AUTHOR OF

"A Treatise on Starters"
and
"Modern Buttermaking and Dairy Arithmetic"

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PREFACE

EW and complex commercial conditions have arisen and crystalized into a new form of activity that demands a change of methods on dairy farms and to some extent, at the creamery. These new problems can only be satisfactorily solved when our dairymen and creamerymen jointly consider and study them.

The dairyman must try to learn some of the fundamental principles that operate and control the final results obtained at the creamery he patronizes. On the other hand, the buttermaker must familiarize himself with dairy farm operations and learn to observe the principles that underlie the production of clean milk and cream.

Unless both dairyman and creamery operator posses some definite and accurate knowledge pertaining to each others work, the best results cannot be obtained.

In order that our dairyman as well as our creameryman may realize most for the time and money spent in behalf of his work, he must necessarily acquaint himself with the latest teachings on subjects pertaining to his work. When he does this, he will not only reduce the cost of the production of butter, milk and cream; but will learn by these new methods how best to invest his money, apply his time and arrange his work.

In view of this great economic change, together with the lack of proper arrangements on dairy farms and the employment of improper methods in the dairy, I have been prompted to publish "The Modern Dairy Guide to Greater Profits."

Thanks are due to Prof. E. H. Farrington for the use of various electrotypes, to Prof. G. H. Benkendorf for his article on Whey Separation in chapter XI, and to Mr. Chas. Steffen, Milwaukee Health Department, for the special contribution on clean milk in chapter IX.

MARTIN H. MEYER.

Madison, Wisconsin.
May, 1913.

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CHAPTER I.

ON THE FEEDING OF DAIRY COWS.

The Good Judgment of the Feeder Makes Profitable his Herd.

1. **The Success Obtained in Handling a Dairy Herd** rests upon a few well defined principles properly carried out and supported by good judgment and insight into the behavior of cows.

Upon the timely attention to any irregularity in the health of cows supplemented by judicious care, depend the profits obtained or losses sustained.

With the dairy barn warm and dry, well lighted and ventilated and roomy enough for bodily comfort, a healthy herd is practically an assured fact.

The surest way to get a cow over any ill feeling or indisposition is to give her good hay, a warm bran mash and plenty of clean bedding.

By feeding a variety of well cured roughage and wholesome concentrates, according to the capacity, productiveness and individuality of your dairy herd, you have laid the foundation for handling your cows in a profitable manner.

The richer the milk is in butter fat, and the larger the quantity of such milk produced by a cow, the richer in fat and protein forming ingredients the food can be without hurting her digestion.

The regular grooming of cows during the winter or when employing the soiling system, is an important factor in the economy of the production of clean milk and cream.

THE PROPER COMPOSITION OF FEED.

2. **Balanced Rations Necessary.** Both practical and scientific men of the past and present have found that the greatest quantity of milk can be produced when wholesome and well balanced rations are fed. A balanced ration is a ration that contains necessary nutriment for the production of the most milk, meat or energy from a given quantity of food.

The average dairy cow should be fed with food making a ration of 1 part of protein, casein or meat forming material to 5, 6 or 7 heat or fat forming ingredients. A ration is the amount of food fed per day.

* "No. I, a Balanced Ration.		No. II, an Unbalanced Ration.	
Corn Silage.....	30 lbs.	Corn Silage.....	30 lbs.
Clover hay.....	8 lbs.	Timothy hay...	5 lbs.
Gluten feed.....4.6	lbs.	Clover hay.....	3 lbs.
Ground Corn...3.3	lbs.	Ground Corn...	8 lbs.
Ratio	1:6	Ratio	1:11

It was found in feeding the above rations to an equal number of cows that those fed on Ration No. I gave $\frac{1}{3}$ more milk than those fed on Ration No. II. The nutritive ratio of Ration No. I is one part of protein to 6 parts of carbohydrates; and of Ration

* Bulletin No. 159, see Agrl. Expt. Sta., Urbana, Ill.

No. II is 1 part of protein to 11 parts of carbohydrates.

It was also found that 6½ cows fed on Ration No. I produced as much as 9 cows fed on Ration No. II. This also means that by feeding the Ration No. II a dairyman loses $10.00 per cow for a period of 131 days, or about $26.90 per cow per year." In a dairy of about 20 cows the dairyman would lose about $538.00. This plainly shows that it pays to study the general composition of the food we feed.

3. COMMON RATIONS.

Corn Ensilage...30 lbs.	Corn Ensilage...20 lbs.
Hay .....12 lbs.	Clover Hay.....15 lbs.
Cornmeal ..... 1 lb.	Cornmeal ..... 4 lbs.
Bran ..... 4 lbs.	Bran ..... 2 lbs.
Oil Meal..... 2 lbs.	Oil Meal..... 3 lbs.

A ration must be increased or decreased according to the size of the cow, her powers of digestion and the quantity and richness of the milk she gives.

Clover Hay.....15 lbs.	Fodder Corn....35 lbs.
Cornmeal ..... 2 lbs.	Bran ..... 3 lbs.
Fodder Corn....15 lbs.	Ground Oats.... 5 lbs.
Ground Oats.... 5 lbs.	Hay ..... 5 lbs.

Cornmeal can be taken out and bran or barley fed instead. Or a little oil meal fed instead of either bran or ground oats.

CHAPTER II.

HOW MILK FROM A HERD MAY VARY IN TEST.

4. **Care and Judgment.** The observant dairyman is conscious of a perceptible temporary variation in the test of the milk of his herd, influenced by feed and care, health of his herd, the season of the year and the lactation period. If he is wise, he recognizes this fundamental truth.

In order to maintain his herd in the best of health, producing normal milk in both quality and quantity, he must necessarily feed regularly a variety of nutritious food, well balanced and suitable for the production of milk.

Dairymen who succeed in maintaining a healthy herd, producing regularly normal milk, have exercised great care and good judgment in the management of their cows.

5. **It is Supposed that Milk is Blood** converted into milk shortly before and during milking. It is only reasonable to believe then, that when the blood of a cow is impure from ill health or from lack of care and bad food, that the milk given under such conditions must also be impure and unwholesome. Not for a moment must we believe that an unhealthy cow can produce normal and wholesome milk.

6. **How Feed may Affect the Test and Flow of Milk.** It is an established fact and widely recognized among both creamery and cheese factory men that feed, combined with the season of the year, exerts a tremendous influence on the general quality of milk and also on the butter and cheese made from it.

Abnormal seasons, such as extremely dry or extremely wet, extremely hot or extremely cold, exert a definite influence on the quality of milk produced. This change in the general quality of milk may indirectly be caused by the food that grew under extreme weather conditions, and may be directly affected by the weather conditions prevailing at the time of milking, caring for and delivering the milk to the factoryman.

7. **Complaints from Creamery and Cheese Factorymen.** Creamerymen complain that their butter is of a soft and greasy body with a peculiar flavor and aroma; the flavor being of a more or less oily nature during extremely dry and hot weather, and of a rather weak body during rainy season and during the spring of the year. When pastures are short and weather dry, the milk is usually more watery — containing less fat and casein. The test drops, making less butter per one hundred pounds of milk than during normal weather.

The cheese factoryman complains of irregular butter fat tests, and smaller yield of cheese per one hundred pounds of milk. Not only that, but the curd at such times is difficult to handle, therefore greater care in handling the curd is necessary. These sudden changes tax to the utmost the skill of the cheesemakers and the buttermakers.

8. **Conditions Patrons Should Remember.** The patrons must remember that the milk they produce can only test regularly and produce good cheese when their cows are in good health, when the food they feed is of good quality, when the water their cows drink is clean and the rations they feed are properly balanced. They must also remember that excitement, sudden changes in the food fed, cows getting wet in cold weather, either from rain or snow and chilling from cold winds, will in every case affect the fat of milk and greatly affect the yield of cheese. Before blaming your hard working painstaking buttermaker for not getting the high quality of butter you had expected, or accusing him of not giving you the test you expected, or criticizing your ever watchful and loyal cheesemaker for not giving you the test you wanted and for not getting as large a yield with as fine quality as you had figured on, think first about the conditions just mentioned, which may have affected the quality of the milk you delivered to them.

9. **How Cold Affects the Milk of the Dairy Cow.** When our rooms are cold, we soon feel uncomfortable and unable to accomplish much work, while after a fire has been built and we feel warm and at ease, our work goes on with dispatch and a great deal of hard work can be done. It is exactly so with the dairy cow. When she is cold and ill at ease, she is building a fire in her own body, with the food you gave her. The food that you had intended should produce butter fat and milk, she uses to keep warm with and then what is left she delivers to you in the form of milk. When you started milking, you found

the udder soft and small. Even your hypnotizing and soothing: "So Bossy, So Bossy, So," does not bring down the usual large quantity of milk. You are disappointed in your cow, and she, if she could talk, would say: "I am very much disappointed in my keeper, because he thinks that I can give as much milk when I am cold as when I am kept warm." Both butter fat and casein are consumed in the cow as fuel with which to keep warm, and when cows must keep themselves warm in cold barns, they cannot give much milk. Combined cold and wet especially tend to shrink the flow of milk. It is, therefore, very necessary to keep cows out of cold rains.

When butter fat sells at thirty to forty cents per pound it makes very expensive fuel with which to keep cows warm, especially when we consider that building material is reasonable in price for the building of warm barns. The dairyman pays taxes on both his land and his cows. He spends high priced labor and uses expensive machinery in growing crops and when this is all done he thoughtlessly feeds this expensive food in a cold stable and runs his cows out into the cold and wet in fall and winter, at the time when cows should be indoors protected from cold rains and cold winds. When the milk flow, through various causes, has been lessened during the early stages of lactation, it is not infrequently found that the flow of milk during the rest of the lactation period is greatly reduced.

10. **Good Care Necessary.** Give the hard working cow all the salt she wants, all the clean water she cares to drink, and then keep her warm and dry

so that she will be able to grind up a great deal of coarse food, which she necessarily must consume in order to produce economically a large quantity of milk. Remember that from all the feed you give her, nature has provided that she keep out enough first to keep herself warm and her system in repair, and then, if there is anything left, she delivers it to you in the form of milk.

CHAPTER III.

SILAGE AS A FOOD FOR DAIRY COWS.

11. **Silage as a Feed.** The modern dairyman has a silo in which he stores corn fodder, corn stover and clover or alfalfa. The silo as a means for economical storing and preserving of food, is to the feeding of stock what cold storage for provisions and the preserving of fruit and vegetables is to people.

The silo supplies the dairymen's stock with succulent feed at a time when no grass grows. In other words, good silage is to stock in winter what grass is to them in summer. Silage greatly lessens the cost of the production of a pound of butter or a pound of beef.

Properly cured silage can easily be kept over into the summer, and fed to advantage in time of drought when pastures are short and fodder corn still immature. When pastures are short and flies troublesome, a small ration of a mixture of corn silage and bran or any other ground feed will help to keep up the flow of milk and assist in maintaining the health of the cows in a normal and vigorous condition.

12. **Necessary Care in Feeding Corn Silage.** In order to be able to get the best results from the feeding of corn silage, we must feed as a part of a ration

such feeds as clover, hay, alfalfa, wheat, bran, oil meal or gluten feed. Corn silage, or any other silage alone, is not an ideal food, but when fed with other feed, silage is a great food—in fact the greatest single food. It is claimed that exclusive feeding of silage, especially when put up while too immature, has an injurious effect upon the health of cows. This may be due to the fact that silage from immature corn fodder, alfalfa or clover, easily turns sour and becomes mushy. Any one kind of cured forage, fed exclusively, is not good. We must feed a variety of foods in order that the best results may be obtained.

13. **Causes Affecting the Quality of Corn Silage.** When fodder corn has grown until the stalk shows the first signs of ripening, when the ear begins to glaze and the kernel is mealy, then is the proper time to cut it for silage purposes. When cut at this stage and properly filled into a good silo, the silage when cured will be found to be of a dark brown color, with a mild sweet corn flavor.

On the other hand, if the corn is cut when too green or immature, with the kernels still in the watery milky stage, or if the fodder is put into the silo when very wet from rains, invariably when cured, the silage will be found to be sour, cold and of a sickly whitish color. It will also be found to ferment quickly when exposed.

Clover for silage should be cut at the stage of growth when the blossoms turn brown. It seems that the stage mentioned as the best time for cutting the corn plant and the clover plant for silage, corresponds to the time when these plants contain the largest percentage if digestible food value.

14. **Alfalfa Silage.** Feeding alfalfa silage with highly nitrogenous concentrated foods, such as oil meal or cottonseed meal, is detrimental both to the production of a full flow of milk and to the health of cows. For instance: A dairyman fed oil meal, cottonseed meal and alfalfa. He soon complained to his creameryman that for some reason his cows were not doing well and were falling off in the production of milk and asked him what he thought was the matter. His creameryman answered him in this way: "You are going to kill your cows unless you feed some corn meal or corn fodder or ground barley with the alfalfa. You are over-feeding your cows with protein." As soon as the change was made the cows began increasing in the flow of milk. This again shows that the dairyman must study the composition of the food he feeds.

15. **Sanitation and the Feeding of Silage.** In order to produce both milk and cream free from silage odors, care must be taken in handling and feeding silage. It is better to feed silage not less than two hours before milking so that odors arising from the silage will pass away by the time milking begins. Nor should the morning feed of silage be placed in the feeding alley the evening before, as is the practice of some dairymen at this time, but should always be taken fresh from the silo when needed. Silage when fresh from the silo is much more appetizing than when left standing in the feeding alley, to become saturated with cow and stable odors by morning feeding time. Do not wet silage when mixing concentrates with it unless you have water-tight, sanitary feeding troughs. The leakage

from troughs will quickly ferment and cause bad odors in the dairy barn. There are no taints harder to get rid of when once in the milk than the odors from silage and stable air. Milk and cream contaminated with these odors have spoiled a great deal of both butter and cheese, and have been the cause of heavy losses incurred from off flavored products.

Silage should always be fed off from the top. When silage is dug down into, the air enters the vertical walls of the silage, spoils the flavor and starts decay so very quickly that unless a very large quantity is fed daily the best part of the silage will be spoiled by such exposure.

16. **Size of Silo.** The approximate size of a round silo for the average dairyman is about thirteen to eighteen feet in diameter and from twenty-four to thirty-two feet in height. A thirteen foot by twenty-six foot silo will feed about fifteen head of cattle; a sixteen foot by thirty-two foot will feed about twenty-two head of cattle; and an eighteen foot by thirty-six foot, about twenty-eight head. It is much better to build two silos thirteen feet by twenty-eight feet each, than one twenty-four feet by forty feet, because silage should not be exposed to the air for too long a time.

It is figured that a cow consumes about thirty to forty-five pounds of silage per day, depending upon the amount of concentrates fed with the silage and the capacity of the cow.

An acre will produce from six to twelve tons of silage and in some instances even more.

17. **Feeding Experiences.**

J. W. Dawson in the Twentieth Century Farmer, May 4, 1912, writes as follows:

"An unusually hard winter, with deep snow following, and an unusually dry summer, with short crops, has brought the live stock owners up against a hard proposition. With about sixty days yet until grass, and hay bringing $20 per ton, the stockman has indeed something to think about. These conditions are creating a widespread interest in the silo.

Much has been written on this subject and many ideas and theories have been voiced, some of them practical and some absurd. The owner of live stock, however, is not interested in either ideas or theories. The question he is asking is, What will a silo do for me? Will it pay under my conditions? Will it help me out of difficulties like the present one?

The best answer to these questions is, try it and see, but the experiences of other men under similar conditions will throw a great deal of light on the subject and perhaps give some of us the courage to try for ourselves.

In setting down these results we are withholding names and addresses of the parties. They are all Nebrasak farmers and we will furnish names and addresses to anyone writing us and asking for them.

First—A farmer milking eighteen cows fed the following ration during the winter of 1909: Daily ration per cow and actual cost on farm:

Four pounds bran at $1.10 per cwt.....	$.044
Six lbs. corn and cob meal at 90c per cwt...	.054
Thirty lbs. alfalfa hay at $10 per ton.....	.150
Total cost per cow.....	$.248

Eighteen cows at 25c per day per cow.....$ 4.50
For six months, or 180 days..... 810.00

That summer he put up and filled a silo, keeping accurate account of the expenses, and for the winter of 1910 he fed the same eighteen cows the following ration:

Thirty pounds of silage at $2.50 per ton... $.037
Ten pounds alfalfa at $10 per ton..... .050
Four lbs. corn and cob meal at 90c per cwt.. .045
Half pound oil meal at $2 per cwt..... .010

Total cost per cow..... $.142
Eighteen cows at 15c per day per cow.....$ 2.70
For six months, or 180 days..... 483.00
Saving in cost of feed in six months..... 324.00
Cost of the silo 265.00

Second—Two men living on neighboring farms joined a cow testing association. Both milked grade Holstein cows and sold their milk to the same party at the same price. Herd No. 1 consisted of twelve cows freshened in early summer. At the time of this record (March) their daily ration per cow was two and one-quarter pounds ground corn, eight pounds alfalfa and forty pounds silage; actual cost on the farm, 11 cents. These cows averaged seventeen pounds of milk per day, which sold for 20 cents, leaving 9 cents profit.

Herd No. 2 consisted of twenty-eight cows freshened in the fall. Their daily ration per cow was: Eight pounds ground corn, two pounds ground barley, two pounds ground oats and twenty-five pounds alfalfa; actual cost on the farm, 28 cents. They av-

eraged twenty-two and one-half pounds of milk per day, which sold for 26½ cents, or 1½ cents less than their feed cost.

Third—A feeder with 200 steers on feed, received an offer of $2,800, or $8 per ton, for his alfalfa crop in December, 1909. As he needed the hay for his steers, he refused to sell. That winter he fed 132 cattle and 1,050 sheep. His books show the following figures:

Cost of silo	$ 650
Cost of silage cutter	256
Cost of erection of silo	100
Forty acres corn at fifty bushels per acre at 40c per bushel	800
To labor in filling silo	200
To interest, depreciation, etc.	60
Total	$2,066
Sold in December, 1910, 200 tons alfalfa at $15 per ton	$3,000
Investment in silo outfit and feed	2,066
Balance in cash on hand	$ 934

Fourth—Last fall a man with a silo full of feed bought of his neighbor who had no silo twenty head of heifers at $16 per head. The man who sold had twenty head left. Both fed through the winter and both sold the same week. The bunch that were fed silage, a little alfalfa and corn, brought $26.

In six years' work among Nebraska farmers, feeders and dairymen we have collected data of many such results.

The extension department of our State Agricultural College found only five men out of 142 who reported that they did not have good results from ensilage feeding. Their investigations show that with an average yield of six tons of corn per acre the average cost of a ton of silage, in the silo ready to feed, is $3.03. In eastern Nebraska, where corn will yield in average years from ten to fifteen tons per acre, silage costs from $1.75 to $2.75 per ton. Even at a cost of $5 per ton it is profitable to replace $10 hay.

Think it over, you stockman."

18. CONCRETE CONSTRUCTION FOR SILOS, BARNS AND HOUSES.

Materials and Methods. No matter what materials or methods are used on concrete work, the resulting mixture if first class will quake like "jelly" or "liver" when shoveled into a pile and struck with the back of the shovel. Lean mixtures show no "life" but on the contrary, settle down "dead" like sand in water. On most small jobs the sand and gravel is used as it comes from the pit. If the soil has been stripped from the bank of gravel the material will usually be clean. Through freezing, lumps of dirt may completely ruin an otherwise good wall. If the material used is a coarse sand and gravel with grains varying in size from fine sand to the size of hickory nuts or larger, one sack of Portland cement should be mixed with 5 to 6 cu. ft. of gravel. If the material used is a fine sand with grains of nearly uniform size, it will require one

sack of cement to about 2½ to 3 cu. ft. of sand in order to get a concrete of equal strength. As a rule, no stone larger than one-fourth or one-third the thickness of the wall or slab for which the concrete is intended should be used.

Concrete can be conveniently mixed in an ordinary mortar trough or on a water-tight platform about 8 ft. or 10 ft. by 12 ft. When mixing by hand, using bank run gravel, thoroughly mix the cement and gravel dry. Then wet and mix some more, using enough water so that the mixture when shoveled into a pile will flatten out of its own weight.

Fine sand is expensive material for concrete. Use coarse sand and gravel or broken stone and use four and one-half to six sacks of Portland cement to every cu. yard of material.

Use enough water and mix thoroughly. Extra mixing increases the strength of the resulting concrete.

On small jobs when the concrete cannot be shovelled into place, it can economically be hoisted in buckets, using a large pulley or wheel and rope.

Protect fresh concrete from sun and wind and sprinkle with water for several days after the forms are removed, especially in hot, dry weather.

A rich concrete, mixed not too wet, will give a good wearing surface without adding a special mortar coat on top, especially if a little cement is sprinkled on the surface with a sieve before the surface is trowelled. Trowel only just enough to smooth the surface after it has been levelled off with a straight edge.

CHAPTER IV.

OPERATING THE HAND SEPARATOR.

19. **The Foundation Must Be Solid.** The machine must be bolted down solid on a level concrete base or a solid wooden floor. The machine must stand true, otherwise much butter fat is lost in skimming. Take your level and test the separatar every two or three weeks, and if it does not stand true, correct it at once.

20. **Getting the Machine Ready for Separating.** In setting up the separator follow the directions that came with your machine. Oil all bearings, adjust all self-oiling oil cups and start the machine slowly, running warm water through the bowl before running milk through, to take out any dust or odors that may have collected on the bowl and its parts since the last separation. The water will remove odors and dust which otherwise would contaminate the cream and cause it to sour and spoil quickly. Be sure to maintain a uniform speed and flow of milk.

21. **After the Milk is Separated.** When the milk is all separated, take some of the freshly separated skim milk and rinse the bowl to remove all butter fat adhering. Now take the machine apart at once and place the different parts in a bucket or tank of warm water. Dissolve some washing powder in this

water and wash the separator as soon as possible. After the machine has been well cleaned, rinse with hot water. Do not wipe with a cloth, but place upon a rack to dry. During the fly season always cover the washed parts with fly netting. Wipe the frame of the machine with a cloth and it is ready to be set up again for the next separation. The machine **must** be washed after every time it has been used.

22. **Cream Varies in Test.** It is common knowledge that cream varies greatly in test between any two deliveries from one patron. This sudden variation in test of one patron's cream from time to time has caused much trouble both to patrons and creamerymen. Not infrequently did the patrons of a creamery blame the creameryman for underreading his cream test, and, on the other hand, the creamery man thought that his patrons were trying to test his honesty and fairness in testing their cream and therefore, were thinning their cream to get a larger quantity, with the idea that it would test the same, or nearly so, and net them more butterfat.

The creamery patron should consider well the explanation given in the following paragraph why cream varies in test when apparently all conditions are the same today as yesterday.

23. **How the Temperature of Milk Affects the Richness of Cream.** Taking 85° F. as the proper temperature for separating milk, the patron will notice that as the temperature of the milk lowers the cream gets richer, and as the temperature is raised the cream will be thinner. This is one reason why cream can vary much in test from one separation to another, especially in winter when one day the milk

may be separated at once after milking and the next day there may be a delay, causing the milk to get too cold, with the result that the cream will be richer.

24. **The Fullness of the Supply Tank** also affects the richness of the cream. The fuller the tank, the thinner the cream and the less milk in the tank, the richer the cream.

25. **The Speed of the Machine.** Within reasonable limits, the slower the speed the thinner the cream and the higher the speed the richer the cream. Irregular speed gives an irregular test and a heavier loss of butter fat in the skim milk.

26. **Unsteady Foundation Causes** also more or less excessive fat losses in the skim milk. A shaky separator with irreguar speed when the milk is a little cold is known to have caused the loss of one per cent in the skim milk or over twenty times more than it should.

27. **An Unclean Separator Causes Heavy Fat Losses.** It is impossible to skim clean with an unclean or dirty separator. When sediment adheres to the inner parts of a separator bowl and is allowed to stay there until the next separation, a perfect separation is impossible. Milk must flow uninterruptedly through the bowl if good skimming is desired. It is for this reason that some dairymen are never satisfied with the returns from their creamery. Some patrons run the butter fat into the skim milk and feed it to their stock, forgetting that butter fat at thirty to forty cents per pound makes very expensive cattle feed.

CHAPTER V.

THE CARE OF CREAM.

28. **Separating and Cooling Cream.** Set freshly separated cream into cold water and stir frequently until cold. When cold pour it into the regular cream can in which it is to be delivered or taken by the cream hauler. The rinsings from the small cream can, into which the cream is separated should not be poured into the cold cream, but should be run through the separator at the end of each separation. These rinsings, with the addition of a little more skim milk or water, will be sufficient to thoroughly rinse the separator bowl free from all fat or cream adhering. Rinsings may only be added to cream when it is very rich; otherwise it will get too thin for good results at the creamery. When this system of handling and cooling is followed, a good quality of cream is the result.

29. **Small Cream Cans Advisable for Cooling Cream.** The shot-gun type of cream can, five to six inches in diameter and sixteen to twenty inches deep, is the best type of can to separate cream into for immediate cooling purposes. Cream or milk cools more quickly in a narrow can than in a wide one. Less cream adheres to a narrow smooth can than to a wide can. For those reasons the ordinary shipping can is not so desirable for cooling cream when fresh from the separator as is a smooth,

narrow, straight-sided can. The cleaning of the small can also can be more easily and thoroughly done and therefore this type of can is more sanitary. This means that cream will keep sweet longer. Furthermore, by using a small can for each separation and adding this shortly before the next separation of milk, to the cold cream in the large can used for this purpose, a finer quality of cream is obtained with less expense and trouble. Every time a fresh lot of cold cream is added to the cold cream in the large can it should be thoroughly stirred and the can tightly covered.

30. **Reasons Why Warm Cream Should Not Be Mixed With Cold Cream.** By adding warm cream the temperature of the cold cream is raised, and the bacteria which have been lying in a dormant condition in the cold cream, now become active and develop all kinds of flavors—some desirable and some undesirable, but mostly undesirable. When once the dormant bacteria become active, they will stay active, even though the cream is again cooled to a lower temperature than it had been cooled to before. This can be explained in the following manner: When a farmer plants corn he knows that the soil must be warm in order to sprout the seed; but when once sprouted, the plant will grow at a lower temperature than the temperature necessary to sprout and start growth. This same principle, that applies to the sprouting of corn, applies to the growth of bacterial life in cream and milk.

Aside from the above reason, the dairyman must stir and cool the warm cream before adding to cold cream to free the warm cream of any odors that it

may contain, and which pass off by cooling and stirring. When warm cream containing odors is added to cold cream and then both are cooled to lower temperature ,almost all undesirable flavors that may have been in the warm cream will remain in the cold cream and develop bad tastes.

31. **Should Cream Cans be Left Open?** When analyzing the principles involved in cooling milk or cream and holding it when cold, we come to the following conclusions. In cooling warm milk or cream, vapors are expelled, due to the contraction of the liquid, and these vapors carry with them odors which are in the milk or cream. There is therefore less danger of contamination from the surrounding air than when cold milk or cream is left uncovered. This is particularly true when cold milk is left uncovered in a room where it gradually grows warmer. Cream or milk should be cooled quickly and when cold it should be kept cold, with the cans closed.

32. **Unwashed Separator Cause of Unclean Cream.** The unwashed and the uncleanly kept hand separator is the direct cause of more poorly flavored, sour and off flavored cream than the dairyman realizes. The unwashed and uncleanly kept separator is teeming with bad germs ready to sprout just as soon as they get into cream or milk. When milk is separated through an unclean machine, germs adhering to it will get into the cream and quickly spoil its flavor. Even though such cream is kept sweet and very little undesirable flavor is noticeable at the time of delivery to the creamery, yet, when ripened at the creamery, the undesirable germs begin to grow in the cream and also in the butter made from

such cream. The result usually is that the commission house handling the butter sends a complaint to the secretary of the creamery.

The dairyman, who is a little slack in properly caring for his separator, thinking that one washing daily is enough, is advised to drink a cupful of the first cream flowing from the separator when it has not been cleaned, or use the cream on hot porridge. This will be convincing.

33. **Rich Cream Most Profitable for the Patron.** The value of cream for butter making is based upon the test of the butter fat and not on quantity or number of pounds alone. The richer the cream is, the more skim milk the patron will have to feed, and the smaller is the quantity of cream to be cared for. Therefore it is more easily cooled, requiring smaller utensils, less ice or cold water, and less hauling expenses. Such cream will keep sweet longer and, therefore, make better butter and sell for a better price. The expense of running a creamery is heavier where patrons bring thin cream than where they bring rich cream.

34. **30% Testing Cream vs. 20% Testing Cream in Creamery Buttermaking.** Patrons of creameries hold that the thinner the cream is which they deliver, the more money they will receive, because the quantity is greater than when a richer cream is delivered.

The following problems will show that an average creamery receiving 150,000 lbs. butter fat annually may lose or gain about $1,700.00 depending on whether the churning cream tests 30% or 20% fat. The butter in each case contains 80% fat.

Creamery No. I Receiving 30% Cream. The buttermilk tests .15%. The amount of fat lost in the buttermilk is 30% (the cream test × 25% (the estimated overrun) plus 30% (cream test), subtracted from 100 lbs. cream, × .15% (the test of the buttermilk). This equals .09375. Multiply this by 500,000 (the total cream) and we get 486.75 lbs. Formula: 100 — (30 × .25 + 30) × .15% × 500,000 = 486.75 pounds. Fat went into the buttermilk.

Total fat received 150,000 lbs. Lost in buttermilk 486.75 lbs. Butter made 186,914 lbs. Overrun 24.6%.

Value of butter at 30c, $56,074.20. Value of fat lost in buttermilk $140.62.

Creamery No. II Receiving 20% Cream. This creamery must receive 250,000 lbs. more cream to produce 150,000 lbs. of butter fat, or 750,000 lbs. The buttermilk tests .25% or slightly higher in thin cream than in richer cream. The butter made also contains 80% fat, the same as with creamery No. I.

The total fat lost in the buttermilk is 100 — (20 × .25 + 20) × .25% × 750,000 = 1,406.25 lbs. or 920 lbs. fat more than was lost when 30% testing cream was churned, valued at 30c or $276.00.

Total butter made is 150,000—1,406.25 ÷ 80% (fat in butter) = 185,742.3 lbs., or 1,172 lbs. less butter than was made from the same amount of butter fat delivered in 30% testing cream. The value of this is $351.60.

This overrun is 23.85% or .75% less than the overrun from 30% cream.

The total amount of buttermilk from this cream is 564,258 lbs. as against 313,086 lbs. in 30% cream, or 251,172 lbs. more from 20% cream. This extra

amount 251,172 lbs. has to be hauled twice over the road at a heavy expense, while this 251,172 lbs. could just as well, and should have been kept at home and fed while sweet. Not only do the patrons lose about $1,700.00 in cash annually by delivering thin cream, but they lose the fine results that are obtained by feeding sweet skimmilk and the satisfaction from the increased stability of their butter market, due to the manufacture of a more uniform butter of higher quality.

Factors In Favor of 30% Cream. It costs about $500.00 less to deliver 150,000 lbs. fat in 30% cream. Makes 1,172 lbs. more butter. Loses 920 lbs. less fat in buttermilk. Leaves 251,172 lbs. more sweet skimmilk on the farm. Saving on labor, ice for cooling, steam and churning expense about $250.00. A saving of an extra cream vat, value about $300.00, complete. 251,172 lbs. skimmilk is worth $250.00 more than the same amount of buttermilk. Furthermore, patrons lose more by an equal error made in testing when they deliver thin than when they deliver rich cream. Suppose a patron brings 200 lbs. of 21% cream and a mistake is made in testing of 1%, this means that instead of giving the patron 200 × .21 = 42 lbs. fat, he gets 200 × 20% or 40 lbs. A loss of 2 lbs. on 42 lbs. or 4¾%. Suppose he brings 31% cream. 200 lbs. × 31 = 62 lbs. fat; by an error he gets 30% or 200 lbs. × 30 = 60 lbs. Here he loses 2 lbs. on 62 lbs. or 3⅕% as against 4¾% loss when 21% cream is delivered.

It pays to bring rich cream, and the patron is the loser in every case when he brings thin cream.

CHAPTER VI.

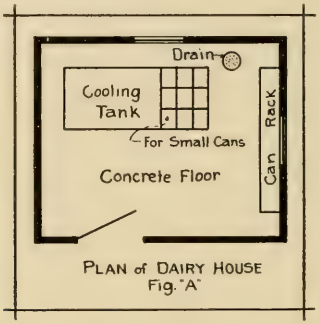
DAIRY HOUSES AND COOLERS.

35. **Least Care Given to Cream or Milk.** Dairymen as a rule exercise great care in the selection and care of their stock. They are very careful in the preparation of the soil, selection of seed, cultivation of the crops and in the cutting and curing of grain and hay. They invest much money in the dairy farm equipment, hire expensive labor and thus are under very heavy expenses. When dairymen have done all those things with great care, they too frequently allow butter fat worth 30—40c per pound to partly lose its flavor and keeping quality by not taking good care of either milk or cream during the early stages of production. Besides this they demand the highest market price for it.

Were dairymen fully conscious of the dangers of the contamination of milk when kept in a poor place at any time after it is drawn, they would take better care of it. We must remember that air coming in contact with milk contaminates it when such air is laden with dust or filled with any odors that we can smell. The key to the production of clean, fine tasting milk, with good keeping qualities, is keeping milk from coming in contact with air and cooling it immediately when drawn.

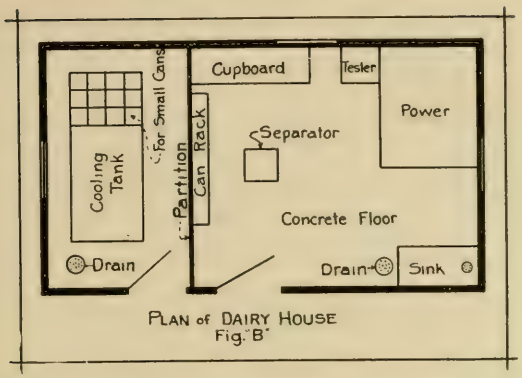
When we consider that most dairymen have all necessary arrangements for their poultry, pigs, cows and horses, we fail to understand why they have not made any provision for the highest priced farm products—milk and cream.

In order to assist the dairyman in building inexpensive dairy coolers and houses so that he may be able to better care for his milk and cream, I submit the following for his careful consideration.



PLAN of DAIRY HOUSE
Fig. "A"

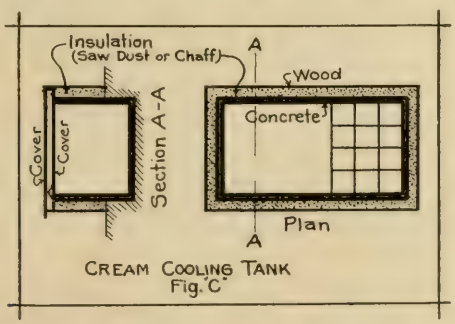
36. **Figure A. Plan of Dairy House.** This plan is a simple design for either concrete or wood construction as desired. It may also be made larger or smaller according to the size of the dairy farm. This plan is also advisable for a dairy house to be constructed in one of the dairy barns in which the milk as soon as drawn can be set in cold water. Immediate cooling is the best way to preserve both milk and cream from early souring. After the milk is all drawn it can be removed farther away from the barn to a special dairy building of this or any other description.



PLAN of DAIRY HOUSE
Fig. B

37. **Figure B. Complete Dairy House Plan.** This kind of a dairy house can be placed either some distance away from the dairy barn or built next to the barn on the end farthest removed from the barn yard.

There are two doors, because the building is partitioned so as not to allow odors from gasoline engine, oils or wash sinks to get into the cooling room.



CREAM COOLING TANK
Fig. C

38. **Figure C. Cream or Milk Cooling Tank.** This is an ordinary concrete tank set one-third in

the ground, with a wooden jacket filled with either sawdust or chaff.

Such a tank can be very conveniently placed in any dairy barn to be used for immediate cooling of milk as it is drawn, unless the milk is to be separated. Such a tank is especially adapted for the cooling of milk for cheese factories, and cream for creameries.

Dairy House Construction.

The walls of whatever material should have an air space to keep the frost out.

The roof should not be flat, but have about 40 degree pitch and form a gable. In each gable allow a screened window to act as a ventilator which will keep the dairy house cool; while a flat roof will make it too hot to work in during the hot months, and difficult to keep the cream or milk cool.

Change the water frequently and connect the cooling tank with the watering trough.

Plant a few trees around the dairy house which will help to make it cool and pleasant.

CHAPTER VII.

THE GRADING OF CREAM.

39. **Dairy Teaching Not Heeded.** To a great extent the dairyman has ignored dairy teachings and has refused to listen to the advice and pleadings of his creameryman, that he take better care of his cream. In a matter-of-fact way some dairymen reply, "I receive the same price for cream which is poorly taken care of as for cream which is well taken care of, so why should I take greater pains in caring for my cream and incur heavier expense, when I do not get paid for it."

40. **A New Departure in Buying and Selling Cream.** From the very beginning of the development of agriculture, farm products, with the exception of dairy products, have been sold according to their quality and purity.

Dairy butter, which varies greatly in quality, is generally accepted by the country merchant on the one quality basis. The country merchant knows that he will lose money by handling this butter, but in order to keep the good will and the store trade of the dairyman he is willing to lose on the butter transaction and regain the loss on the store trade.

This system of paying one price regardless of the quality, has established the wrong idea of a right

standard of quality in the minds of dairymen and they firmly believe that all butter is good butter and therefore, demand the highest price for their dairy butter. Since the dairyman received in the past the same price for dairy butter, he now feels that he is entitled to the same price for his cream regardless of its quality. This method of paying the same price for poor as for good dairy butter has extended its bad influences to the selling of cream and is working against maintaining a high standard of quality in butter and the enforcement of selling and buying cream by grade.

In spite of up-to-date creamery methods, high class dairy teaching and properly trained buttermakers, the quality of the butter on the market today is not getting better, and this is due to poor cream. It is hoped that the turning point toward permanent improvement in the quality of cream has come with the establishment of the grading system and the building of little dairy houses and coolers and better dairy barns for better caring for cream or milk.

41. **Why Cream Should be Graded.** When a dairyman offers for sale two dairy cows that differ much in their milk production and age, he does not expect to receive the same price for each.

Business ordinarily is organized on the basis of quality, and all transactions are governed by the quality of the product under consideration and the price regulated accordingly.

When we cease to pay for efficiency we cease to get efficiency. When we stop paying for what

quality is worth, we will not get quality. By paying the same price for poor cream as for good cream we destroy the only commercial incentive conducive to the production of a better grade cream.

42. **Grading of Cream the Only Solution.** The only solution then, according to the principles that govern the quality of cream, lies in grading and paying less for poor cream than for good cream. This seems to be the only way to get a permanent improvement in the quality of cream. Not until a sufficient difference in price is made can we hope for a better quality of cream and a finer quality of butter.

Prof. G. H. Benkendorf of the Wisconsin Dairy School, Madison, Wis., in Bul. No. 220, writes:

"If the quality of the 105,000,000 pounds of butter made in Wisconsin each year could be so improved that its value increased one cent per pound, there would be an addition of a little over $1,000,000 per year to the receipts for butter made in this state."

43. **Examples Showing Losses From Poor Cream.** Suppose twenty patrons patronize a creamery. Ten of these bring first class cream and the other ten bring second class cream. The total butter fat delivered each year amounted to 100,000 pounds. 50,000 pounds is first class butter fat and 50,000 pounds is second class butter fat. First class butter fat sold at thirty-two cents per pound, but when both the poor and good cream were mixed and churned the butter sold for two cents less, that is, for thirty cents, instead of thirty-two cents per pound. Churning both good and poor cream to-

gether is the general practice and cannot be differently done at the present time, except in creameries of sufficient size.

44. **When Paying the Same Price for Poor and for Good Cream According to Above.**

Extras, 1st class cream butter sells at	$.32	per pound
Butter made at the creamery sells at	.30	" "
Patrons bringing poor cream receive	.30	" "
Patrons bringing good cream receive	.30	" "
Patrons bringing good cream lose	.02	" "
Patrons bringing poor cream gain	.02	" "

Proving the above.

Total butter fat, 100,000 pounds at $.32	= $32,000
Butter sold at 30c × 100,000	= $30,000

A total loss of $2,000.00, or $200.00 for each patron each year bringing good cream and a gain of $200.00 for each patron bringing poor cream. In other words, the ten patrons bringing good cream paid $200.00 each, every year, to the ten patrons bringing poor cream as an encouragement to keep on bringing poor cream, without one word of protest, except reprimanding their buttermaker for not making better butter from their cream.

45. **Paying Patrons According to the Grade of Cream They Bring.**

When butter sells as Extras,	$.32	per pound
Price received for butter,	.30	" "
Patrons bringing good cream receive	.32	" "
Patrons bringing poor cream receive	.28	" "
Difference paid per pound,	.04	" "

46. Proving the Above Illustration: Total butter fat received 100,000 pounds; sold for $.30 per pound;

losing \$.32—30 = \$.02 per pound, or 100,000 pounds × 2c = \$2,000.00 on all cream received each year. This loss was caused by ten patrons bringing 50,000 pounds of poor butter fat in cream. A loss of \$2,000.00 on 50,000 pounds of butter fat equals \$2,000.00 ÷ 50,000 pounds, or 4c per pound.

Proving It Another Way:

Ten patrons bringing 50,000 pounds of good butter fat at \$.32 = \$16,000.00.
Ten patrons bringing 50,000 pounds of poor butter fat at \$.28 = \$14,000.00.
Total paid out to both kinds of patrons, \$30,000.00.
Total money received for 100,000 pounds at \$.30 = \$30,000.00.

The overrun is not taken into consideration in these problems, for the reason that patrons are paid for butter fat at the price received for butter, and the overrun goes to cover running expenses.

There are a large number of co-operative creameries conducting their business in the same manner as illustrated above. Under these conditions a dairyman keeping twenty cows, each producing 250 pounds of butter fat, or 5,000 pounds each year, may lose or gain about \$2,000.00 during ten years. If the dairyman takes good care of his cream he saves \$2,000.00, but when one-half of the patrons, as illustrated above, bring poor cream, and all get paid the same price, each patron bringing good cream has in ten years paid \$2,000.00 to the patrons bringing poor cream—enough to build a handsome and complete dairy barn.

This $2,000.00 is saved on a twenty cow dairy farm. On a thirty cow dairy farm it will be $3,000.00 and on a large one hundred dairy farm it amounts to $10,000.00 in ten years, or $1,000.00 in one year.

I would ask patrons to no longer pay their hard earned money to those who do not care to take better care of their cream, but to insist on the grading of cream.

47. **Finding the Price for the Butter Fat Delivered in Poor Cream in Co-operative Creameries.** Rule: Multiply the loss per pound caused by poor cream by the number of pounds of butter on which the reduction was made. Now find the number of pounds of butter fat in the poor cream and divide the total loss by the pounds of butter fat in poor cream. The quotient is the average price per pound lost. Subtract the average price lost per pound from the price quoted for good cream butter and the result is the price to be paid for butter fat delivered in poor cream. Multiply the pounds of butter fat in each patron's poor cream and the result is the money due him.

48. **Illustrating the Working of the Above Rule.** A creamery receives monthly 20,000 pounds of butter fat; total good cream delivered 15,000 pounds of butter fat; total poor cream delivered 5,000 pounds; average uniform price 35c per pound. On two weekly shipments a cut of one cent was made, or a cut of one cent on 10,000 pounds $\times$ 1c = $100.00 loss. $100.00 $\div$ 5,000 pounds poor butter fat = 2c per pound. Price of good cream butter 35c less 2c = 33c to be paid. Patron A delivers 200 pounds of cream

testing 30% = 60 pounds of butter fat. 60 × 33c = $19.80 instead of $21.00 he would have received if his cream had been good.

49. **Another Method of Paying for Cream.** It seems that the most satisfactory method for both the dairyman and creameryman, whether co-operative or individual management, is to pay each patron according to the quality of the cream he brings. This price varies from three to ten cents per pound, according to the condition of the cream.

Date	Patron	Fat Lbs. Del.	Grade	Price	Value @ 32c	Losses
Jan. 3,	A	30	2nd	25c	$7.50	$2.10
Jan. 6,	A	25	1st	32c	$8.00	
Jan. 10,	A	28	1st	32c	$8.96	
Jan. 15,	A	45	2nd	25c	$11.25	$3.15
Total,		128				$5.25

There are many creameries that have had a loss from one to five cents per pound on all butter made, due to the delivery of such cream as patron A brought to his creamery, on January 3rd and 15th. Suppose that patron A's cream delivered on January 15th caused a loss of one-half cent per pound in a churning containing 1,200 pounds of butter, or $6.00. Here the $3.15 which patron A received less for his cream caused a loss of $6.00 to the creamery company.

50. **A Few Cans of Poor Cream May Cause Heavy Losses in a Single Churning.** In practical creamery butter making it is not uncommon to lose very heavily in a single churning on account of a can or two of poor cream. I firmly believe that if patrons had experience in creamery buttermaking, they would

not deliver so much poorly taken care of cream, nor would they blame their buttermaker for all the poor butter made. How can a buttermaker manufacture good butter from old cream when a "christian soldier" could not have done it?

A FEW ACTUALLY KNOWN LOSSES.

Twenty-five pounds of bitter flavored cream added to 1,600 pounds of fine, clean, pasteurized cream making 600 pounds of butter caused a loss of five cents per pound, or $30.00 in one churning. Another instance: A patron delivered three eight-gallon cans of 25% testing cream, containing 48 pounds of butter fat, causing a loss of one cent per pound, or $8.00 in the churning of 800 pounds. This one patron, causing a loss of $8.00, should not have received 35c per pound, but only 18c per pound. He delivered 48 pounds of butter fat at 35c per pound, amounting to $16.80, causing a loss of $8.00. $1680 — $8.00 = $8.80; 48 pounds at 18c = $8.64. Is it just to allow poor cream to spoil the market value of butter and then have those patrons who bring good cream stand the loss caused by the poor cream?

These few instances clearly show the present condition on dairy farms, the attitude of the patron toward the production of better cream, the lack of knowledge on the part of the dairyman in providing for better care of milk and cream and the instability of intensive co-operation.

There is not a book large enough to hold experiences of troubles and losses caused by poor cream, yet in the face of all these troubles and

losses, patrons continue year after year to deliver cream that is not well taken care of, thereby causing heavy losses and accepting such losses in many instances as a matter of course. On the other hand, where patrons do not take so kindly to such losses, the hard working and painstaking buttermaker comes in for a heavy share of the blame which he does not deserve. I wish the patrons to remember that buttermakers, as a class, are ten years ahead of their patrons in the understanding of the problems pertaining to their work; but no buttermaker can make good butter from poor cream.

51. **Do Not Blame the Commission Man When the Butter Does Not Sell.** I wish to impress firmly upon the minds of both the dairyman and the creameryman, that unless the butter is off flavored and cannot be sold for full market price, the commission man will sell it for the highest price. In many instances, should the creamery buttermaker receive his own butter at the commission house, he would not believe that it was his butter, and this is not due to any fault of his, but to cream which has not been properly cared for.

52. **How to Establish the Grading of Cream.** The foregoing facts are sufficient to make it clear to the patron that selling cream by grade is best for his interests first, last and all time. The patrons taking good care of their cream are getting less for their butter fat than they should, and those who bring poor cream to the creamery are getting more than they should. The painstaking patrons have been losing thousands of dollars through the carelessness of some neighboring patron.

Call a meeting of all your creamery patrons and put the grading of cream plainly before them. Insist, that from now on, those who take good care of their cream will not stand for the losses caused by those who bring poor cream. Good cream should bring top market price, and poor cream less. Arrange to have your buttermaker grade all cream and pay each patron what rightly belongs to him.

53. **Only Two Grades Necessary.** First and second grades are sufficient for properly grading cream, and simple enough for laying a permanent foundation for the improvement of the quality of cream used for butter making. Two grades of cream are easily recorded at the creamery and any difference as to quality which may arise is not difficult to explain to patrons.

54. **Standard for First Class Cream.** All cream that is sweet and clean, slightly acid, if otherwise clean, or any cream good enough for making first class butter.

Acidity not to exceed three-tenths to four-tenths per cent unless very clean otherwise.

Butter Fat Test Should Not be Less Than 25%.

55. **Standard for Second Class Cream.** All cream not grading first class, but good enough for making butter grading second and better. There cannot be any definite standard for acidity in the second grade. The butter fat test should not be less than 20% and this should be raised as soon as practicable.

Regarding Standards. The per cent of acidity, as well as the per cent of fat that cream should contain in order that the grade be determined, must for

final settlement rest with the person doing the grading. This also holds good with regard to flavor and aroma in cream.

The standards here suggested are to serve as a guide only and not as a set standard used in establishing the grading of cream.

56. **Facts to be Considered in Grading Cream:**

1. No hard and fast rule can be laid down which will apply equally to all cases.

2. Cream may be quite sour and still make good butter, providing it is both clean and rich in butter fat.

3. Cream may be sweet and rich and still not good enough for making first class butter. Such cream may contain peculiar flavors.

4. Age alone is not always an indication that cream does not make a fairly good grade of butter.

5. A delicate sense of smell is the chief asset in quickly and accurately grading cream. Other measures are of only secondary importance and their application is only necessary in case a difference of opinion arises about the grade of cream.

6. The acid test is not practical where cream is graded as gathered, due to weather conditions, as well as the difficulty of handling an acidity outfit on the road.

CHAPTER VIII.

THE OVERRUN IN BUTTER MAKING.

The Overrun is to Creamery Butter Making what a water gauge is to a boiler and a steam gauge to an engine. The amount of overrun a creamery obtains is a true index to its method of management. Upon the per cent of overrun obtained rests the success or failure of any creamery. It is important to know the per cent of overrun obtained as well as to know whether the overrun is a true or a false one. The creamery man should know whether calculations are based upon the number of pounds of butter fat received in milk or cream, and whether the weight of butter from the churn, or the weight taken from market returns constitutes the basis of overrun.

57. **The Overrun.** The amount of overrun is influenced by the composition of the butter made and varies according to the variation in the composition of the butter. The maximum overrun which can be obtained is governed by established standards of moisture and butter fat, and is locally influenced by the demands of commission houses for butter of a certain composition. In order to be able to demand a certain overrun from creameries, we must know what kind of butter their market demands, as well

as what system of cream getting is practiced and the method of calculation employed.

The efficiency of the working of a creamery cannot be accurately judged by the per cent of overrun obtained, unless intelligent inquiry has been made as to the basis on which the overrun is calculated.

58. **Definitions and Explanations.** (a) The overrun is the amount of butter made in excess of the amount of butter fat bought, whether this is in milk or cream. The amount of butter made in excess of the butter fat is called overrun because more butter is made than there is butter fat.

The term "yield" should not be used as meaning overrun in butter making. This term is properly applied in cheese making, meaning the amount of cheese made, either per hundred pounds of milk or per pounds of butter fat in one hundred pounds of milk.

(b) The Per Cent of Overrun. By the per cent of overrun we mean the quantity of butter made in excess of every hundred pounds of butter fat received and made into butter. When the overrun is eighteen per cent it means that for every one hundred pounds of butter fat, one hundred and eighteen pounds of butter were made.

(c) Percentage of Overrun. By percentage of overrun we mean the quantity of butter made in excess of any quantity of butter fat received and made into butter.

59. **Cause of Overrun.** The overrun is due to the incorporation of salt, casein, moisture and other minor ingredients which enter into the composition

of milk and are retained by the butter in the process of manufacture. The main factor affecting the overrun is the variation in the per cent of salt and moisture present in the butter.

60. **Variations in Overrun in Whole Milk Creameries.** Where whole milk is received, the overrun is influenced by errors in weighing, in sampling, in caring for samples, in reading tests, as well as by spilling milk, by inefficient separating, by not flushing separator bowls, by leaky vats, by lack of attention during pasteurization, by improper ripening of cream, by insufficient cooling before churning, by churning at abnormal temperatures, by churning in a leaky churn, and by employing improper methods in washing, salting, working and handling the butter.

Variations in Overrun in Hand Separator Cream Creameries. In a hand separator cream creamery we find all of the above causes affecting the overrun, except the loss sustained through mistakes in the separating of milk. In addition to these we have the spilling of cream during transit (it having been weighed at the farm by hauler), the taking of cream from cans on the way to creamery, and favoritism shown patrons by hauler taking the sample of cream before the rinsings have been added and the cream weighed and recorded.

True and False Overrun. True Overrun. The only correct or true overrun is the overrun determined by basing calculations upon the total amount of butter fat received and the amount of butter made, according to its weight after being taken from the churn, packed and weighed. Any losses occur-

ring later, through the handling or holding of butter are termed either avoidable or unavoidable losses, and do not affect the true overrun. In order to fully explain the difference between the true and false overrun, one problem will be used as a basis for comparison and will be used in each case to show the difference between the two.

61. **Problem**: Received in 20,000 lbs. of 4% milk, 800 lbs. of butter fat. From this 975 lbs. of butter were made. What is the true overrun expressed both in per cent and percentage? Answer: Percentage of overrun 175 lbs. Per cent of overrun 21.875 per cent.

In figuring the true overrun for both whole milk and hand separator cream creameries, 2 per cent losses are allowed for whole milk creameries and 1 per cent losses are allowed for hand separator cream creameries on the total butter fat received. Solution for whole milk creameries: Butter fat received = 800 lbs.; butter made = 975 lbs.; difference = 975 —800 = 175 lbs.; per cent of overrun would be: $(175 \div 800) \times 100 = 21.875\%$.

Percentage of overrun would be: $800 \times 21.875 \div 100 = 175$ lbs. The true overrun is 21.875%.

62. **Market Overrun.** (False Overrun). Overrun calculations based upon any other basis than the above standard are called "false," as, for instance, when the overrun is based upon the total fat received and the market weight of butter sold. From personal experience, as well as from reports received from hundreds of creameries, the losses sustained in the handling of butter from the time it is taken from the churn, are assumed to be about 1¼ per cent.

When we include the loss of 2 per cent incident to the handling of the butter fat before and during churning, the total loss would be about 3¼ per cent of the total butter fat received in whole milk. In hand separator cream the loss is about 1 per cent less, except where a number of cream buying stations or wagon cream routes are connected with the creamery. In this case the difference between the total butter fat bought of the patrons and the butter fat actually recovered in the butter varies from 2 to 5 per cent of the total butter fat bought.

Overrun Based Upon Market Returns. To illustrate: Butter fat received = 800 lbs:; butter made = 975 lbs. Loss sustained = 1¼% of 975 or 12.1875 lbs. Market return weight = 975—12.1875 or 962.-8125 lbs. Market overrun = 962.8125—800 or 162.-8125 lbs. (162.8125 ÷ 800) × 100 = 20.35 + %.

Another false overrun frequently met with is the overrun obtained when calculations are based upon the composition of butter, no allowance being made for losses sustained at the creamery after churning or during transit.

Overrun Based Upon Composition of Butter. To illustrate: Butter fat received = 800 lbs.; loss at creamery 2% (800 × 2) ÷ 100 = 16 lbs. loss.

Butter fat recovered in butter: (800—16) or 784 lbs. Butter made = 975 lbs.

Per cent of overrun: 975—784 = 191 lbs. the overrun in lbs.; 191 ÷ 784 = .2436 the overrun for each pound of butter fat; and for every 100 lbs. the overrun is .2436 × 100 = 24.36%.

Overrun based upon the composition of butter 24.36%.

Market overrun 20.35%.

True overrun 21.875%.

Making 975 lbs. of butter from 784 lbs. of actually recovered butter fat, we get the following composition: Fat 81.41 per cent, salt 2.70 per cent, casein 1 per cent and moisture 15.89 per cent, making up the total of 100 per cent.

63. **How to Find the Per Cent.** of Butter Fat in Butter when the amount of butter made, butter fat received, and losses at the creamery are known, as per the given composition.

Butter made is 975 lbs., butter fat received is 800 lbs., loss at creamery is 2 per cent.

Butter fat = 800 lbs.; Loss = $(800 \times 2) \div 100$ = 16 lbs.

Butter fat in butter is: 800 — 16 or 784 lbs.

Butter made: 975 lbs.

Per cent. butter fat in butter = $(784 \div 975) \times 100 = 80.41 +$ %. Ans.

The overrun on butter of such composition as tabulated below is: 24.36 per cent., based upon the composition of butter.

Fat 80.41 per cent., salt 2.70 per cent., casein 1 per cent., water 15.89 per cent. Total 100 per cent.

Hand Separator Cream Overrun. Assuming that butter of the same composition is made as was made in the foregoing in a whole milk creamery, the loss at creamery being 1 per cent.

64. **The True Overrun**: Butter fat received: 800 lbs.; butter fat in butter made: 80.41%.

(800 × 1) ÷ 100 = 8 lbs. loss; 800 — 8 = 792 lbs. fat made into butter; (792 ÷ 80.41) × 100 = 984.94 lbs. butter made. Per cent overrun = 984.94 — 800 = 184.94; (184.94 ÷ 800) × 100 = 23.12% overrun.

Comparison of True Overrun.

Whole milk cream overrun: 21.875%.

Hand separator cream overrun: 23.12%.

Difference between the two: 1.245%.

This means that for every 1 per cent. of butter fat saved at the creamery, there is an approximate increase of 1.245 per cent on the overrun, when butter is made in composition as above illustrated.

65. **Market Overrun.** Hand separator cream.

Problem: Received 800 lbs. butter fat. Made 984.94 lbs. butter. Loss 1¼ per cent.

(984.94 × 1¼) ÷ 100 = 12.31 lbs. loss.

Market return weight = 984.94 — 12.31 = 972.63 lbs.

Per cent. overrun = 972.63 — 800 = 172.63; (172.63 ÷ 800) × 100 = 21.58%.

Overrun Based Upon Composition of Butter.

Composition.

Butter fat	80.41
Salt	2.70
Casein	1.00
Water	15.89
Total	100.00

Problem: Received 800 lbs. fat which made 984.94 lbs. butter; allowing 1% for mechanical losses.

Solution: $(800 + 1) \div 100 = 8$ lbs. lass. $800 - 8 = 792$ lbs. butter fat in butter. Overrun $= 984.94 - 792 = 192.92$; $(192.92 \div 792) \times 100 = 24.36\%$.

66. **Comparison of Various Overruns.**

Whole Milk Cream.

True overrun	21.875%
Market overrun	20.35 %
Composition of butter overrun	24.36 %

Hand Separator Cream.

True overrun	23.12 %
Market overrun	21.58 %
Composition of butter overrun	24.36 %

The above overruns are based upon the same amount of butter fat received in both milk and cream, and made into butter having the same composition. It was assumed that the tests were properly read.

The composition of butter was: Fat 80.41 per cent, salt 2.70 per cent, water 15.89 per cent, casein 1.00 per cent. For mechanical losses 2 per cent was allowed on whole milk cream, and 1 per cent was allowed on hand separator cream, on every 100 lbs. of butter fat received. For losses during transit 1¼ per cent was allowed on whole milk and on hand separator cream.

Since the overrun is influenced by such a variety of conditions, and the calculations for determining

it are based upon both true and false standards, it is not to be wondered at that our practical dairymen, as well as others interested in dairying, do not more clearly understand this phase of the work. In order to more clearly understand the results embodied in monthly statements issued by creameries, the creamery secretary and the butter maker should acquaint themselves with the fundamental principles involved, and the basis upon which the overrun is determined. Not only should the butter maker and creamery secretary know how to determine the overrun intelligently, but instructors and inspectors, who are supposed to instruct the dairymen, should understand this important part of creamery work. Demanding a given overrun, which is not in harmony with honest work, may lead many creamery operators to under read the test of milk and cream.

67. **Overrun for a Whole Milk Creamery.** In the following, Table No. 4, is shown the overrun that it is possible to get from 800 lbs. of butter fat when butter made varies in fat content.

Variations in Overrun.

From the table on page 51 it will be noticed that when a creamery obtains an overrun of 17—18 per cent, the butter must contain 82 per cent. fat, 15 per cent. water, 2.5 per cent. salt and 1 per cent. casein. Mechanical losses must not be more than 2.5 per cent., and shrinkage or allowance during transit must not be more than 1 per cent. of the butter man-

Table IV.

Variations in Overrun.

Per cent of fat in butter	80.41	81	82	83	84	85
Creamery loss in per cent	2	2	2	2	2	2
Creamery loss in pounds	16	16	16	16	16	16
Number of lbs. of butterfat	784	784	784	784	784	784
Number lbs. of butter made	975	967.9	956.09	944.58	933.33	922.35
Percent of market shrinkage	1¼	1¼	1¼	1¼	1¼	1¼
Pounds of market shrinkage	12.19	12.09	11.94	11.8	11.67	11.53
Market weight in pounds	962.8	955.81	944.05	931.78	922.38	910.82
Per cent overrun on composition of butter	24.36	23.45	21.95	20.48	19.05	17.64
Per cent of market overrun	20.35	19.48	18.00	16.47	15.29	13.84
Per cent of true overrun	21.87+	20.99—	19.51	18.07	16.75+	15.29
Per cent of moisture	15.89	15.30	14.30	13.30	12.30	11.30
Per cent of salt	2.70	2.70	2.70	2.70	2.70	2.70
Per cent of casein	1	1	1	1	1	1

ufactured. As the moisture increases and fat decreases in butter the overrun increases or decreases.

Overrun for a Hand Separator Cream Creamery. The following table shows the various overruns that a creamery can rightly obtain, using 800 lbs. of butter fat as a basis, and making butter which varies in the per cent. of butter fat.

68. **Various Overruns, According Per Cent. Fat in Butter.** (See table on page 53.)

When hand separator cream is delivered by patrons themselves, when testing and weighing are properly done the overrun should come close to that indicated in the above table. When cream is bought through receiving stations the overrun is very often less than indicated in the foregoing table.

69. **In the tables on pages 51 and 53 is found** the per cent of overrun which can rightly be obtained under the conditions presented. When butter is printed or moulded direct from the churn, the weight of the butter then constitutes the basis on which to determine both the true and the market overrun. In this case there are no losses between the first weight and the market weight. Unless butter so put up does not have full weight, the overrun obtained when butter is moulded or printed is a trifle less than that obtained when butter is packed in tubs or boxes. When butter is printed, we may, for practical purposes, call the market weight the weight for the true overrun, thus having the true and the market overrun the same. In print butter there is no difference made between the creamery and the market weight.

Table V.

Various Overruns According to Per Cent. Fat in Butter.

Per cent of fat in butter	80.41	81	82	83	84	85
Per cent of creamery loss	1	1	1	1	1	1
Pounds of butter fat creamery loss	8	8	8	8	8	8
Pounds of butter fat in butter	792	792	792	792	792	792
Pounds of butter made	984.94	977.77	965.85	954.21	942.85	931.76
Per cent of market shrinkage	1¼	1¼	1¼	1¼	1¼	1¼
Pounds of market shrinkage	12.31	12.22	12.07	11.92	11.78	11.64
Market weight—pounds	972.63	965.55	953.78	942.29	931.07	920.12
Per cent overrun on composition of butter	24.36	23.45	21.95	20.48	19.05	17.64
Per cent of market overrun	21.58	20.69	19.22	17.78	16.38	15.01
Per cent of true overrun	23.12	22.22	20.73	19.27	17.85	16.47
Per cent of moisture	15.89	15.30	14.30	13.30	12.30	11.30
Per cent of salt	2.70	2.70	2.70	2.70	2.70	2.70
Per cent of casein	1	1	1	1	1	1

The overrun is increased or decreased according as the per cent. of salt is increased or decreased, unless the moisture is decreased and increased accordingly. The amount of casein is usually about the same, varying very slightly in butter made from good, well ripened and properly churned cream. As a rule the per cent. of casein increases as the quality of the cream changes from good to poor. It can be increased considerably by mechanical methods, but this practice should be discouraged, not only on the grounds of honesty, but also for the reason that an increase of casein is usually attended by a poorer quality of butter. Casein should not be considered a factor in controlling the composition of butter.

Table VI.

The Following Table Shows How Under-reading 4% Milk .1 to .5%, When Receiving 20,000 lbs. of Milk Affects the Overrun.

20,000 lbs. of milk received. It tests	Butter fat in milk according to various tests	Total butter fat in butter	Per cent of butter fat in butter	Lbs. of butter made	Per cent of true overrun	Per cent of false overrun due to underreading	Per cent of increase in overrun due to underreading
4%	800 lbs.	784 lbs.	80	980	22.50	....	....
3.9%	780 lbs.	784 lbs.	80	980	22.50	25.64	3.14
3.8%	760 lbs.	784 lbs.	80	980	22.50	28.94	6.44
3.7%	740 lbs.	784 lbs.	80	980	22.50	32.44	9.94
3.6%	720 lbs.	784 lbs.	80	980	22.50	36.11	13.60
3.5%	700 lbs.	784 lbs.	80	980	22.50	40.00	17.50

From this table it will be seen that for every .1 per cent of under-reading of the milk test when butter having 80 per cent. butter fat is made, the overrun is increased 3.14 per cent., or an increase of 24.5 pounds of butter on 800 pounds of butter fat.

Extension of Table No. VI.

Table VII.

Increase in butter lbs. per .1% daily under-reading.	Increase per day at 25c per pound.	Increase in one year of 300 days.	Increase in one year when 40,000 pounds of milk is received daily.
.1% = 24.5 lbs.	$ 6.125	$1,837.90	$ 3,675
.2% = 49. lbs.	12.25	3.675.00	7,350
.3% = 73.5 lbs.	18.37+	5,511.00	11,022
.4% = 98. lbs.	24.50	7,350.00	14,700
.5% = 122.5 lbs.	30.625	9,186.00	18,372

If a person is not properly trained in reading tests, or is not careful in making the tests, it can easily be seen from the foregoing tables that great losses can be caused, both to the patrons and shareholders of a creamery. The lower the test of milk, the greater is the difference in overrun for every .1 per cent. of over or under-reading.

Table VIII.

71. How Over-reading Affects the Overrun.

Over-reading test by .1%.	Butter fat in 20,000 lbs. of milk	Pounds of butter made.	Per cent of true overrun.	Per cent of false overrun.	Per cent of decrease in overrun.
Correct test 4 %	800 lbs.	980	22.50	.....	.....
4.1%	820 lbs.	980	22.50	19.51	2.99
4.2%	840 lbs.	980	22.50	16.67—	5.83
4.3%	860 lbs.	980	22.50	13.95+	8.55
4.4%	880 lbs.	980	22.50	11.36	11.14
4.5%	900 lbs.	980	22.50	8.88	13.62

By reading the test .1 per cent. too low, on 4 per cent. milk the overrun is increased 3.14 per cent., Table VI; and by reading the test .1 per cent. too high on 4 per cent. milk, the overrun is reduced 2.99 per cent., Table No. VIII. This shows how easily the overrun may be reduced by reading the test while the test is too hot, and how easily it can be increased by reading the test when it is too cold, or by including the full meniscus, or by not including the meniscus in reading milk tests. Not only is the overrun affected by the above mentioned conditions, but not infrequently by deliberate over or under-reading of milk or cream tests.

72. **The Effect of Under-reading Cream Tests.** Table No. IX. Assuming that 800 lbs. of butter fat is received in 3,200 lbs. of cream testing 25 per cent. Butter made contains 80 per cent. butter fat and the loss incident to its manufacture is 1 per cent.

Table IX.

The Effect of Under-reading Cream Tests.

200 lbs. of cream. Test of cream.	No. of lbs. of butter fat in cream.	Total lbs. of butter fat in butter.	Per cent of butter fat in butter.	No. of lbs. of butter made.	Per cent of true overrun.	Per cent of false overrun due to reduced reading.	Per cent increase of overrun per .5% reduc. reading
Correct test 25 %	800	792	80	990	23.75	.....	.....
24.5%	784	792	80	990	23.75	26.27	2.52
24 %	768	792	80	990	23.75	28.90	5.15
23.5%	752	792	80	990	23.75	31.64	7.89
23 %	736	792	80	990	23.75	34.51	10.76
22.5%	720	792	80	990	23.75	37.50	13.75

The above table shows that for every .5 per cent. reduction in reading 25 per cent. cream, the overrun is increased by about 2.7 per cent. The higher the cream tests are, the less is the increase of the overrun due to reduced reading.

Table No. X, continuation of table No. IX. Showing increase in lbs. and value at 25c per lb.

Table X.

Continuation of Above Table No. IX, Showing Increase in lbs. and Value at 25 cents per lb.

Readings reduced from .5% to 2.5%.	Butter lbs. increase due to reduced reading daily.	Value at 25c per lb. daily.	Value during one year of 300 days.	Value when 6400 lbs. is received daily for one year.
.5%	19.8	$4.95	$1,485	$2,970
1. %	39.6	9.80	2,940	5,880
1.5%	59.4	14.85	4,455	8,910
2. %	79.2	19.80	5,940	11,880
2.5%	99.	24.75	7,425	14,850

That great care should be exercised at cream buying stations is clearly shown in the foregoing tables. The amount of butter fat bought should check up to within 2 per cent. of the amount found to be in the cream when tested at the central station. When cream is bought at a receiving station the overrun is very likely to be from 2 per cent. to 2½ per cent., or even 4 per cent. less than when cream is delivered directly to the creamery.

Butter Fat in Milk Plus One-sixth Equals the Amount of Butter Made.

The approximate amount of butter which can be made from any given number of pounds of butter fat is found by adding one-sixth of itself to the number of pounds of butter fat. This is true when but-

ter having about 82½ per cent. butter fat is made. This was agreed upon by the Association of American Agricultural Colleges and Experiment Stations at their ninth annual convention.

The amount of butter which can be made from any given amount of butter fat also depends largely upon the composition of butter made; therefore the results obtained may be either higher or lower than results given in the preceding pages.

The per cent. of overrun is no true indication of the composition of butter, nor is the composition of butter a true indication of the per cent. of overrun.

73. **The Effect of Over-reading Cream Tests.** Assuming that 800 lbs. of butter fat are received in 3,200 lbs. of cream testing 25 per cent. Butter made contains 80 per cent. butter fat. Loss incident to manufacture is 1 per cent.

Table XI.

The Effect of Over-reading Cream Tests.

200 lbs. of cream. Test of cream.	No. of lbs. butter fat in butter.	Total lbs. of butter fat in butter.	Per cent of butter fat in butter.	No. of lbs. of butter made.	Per cent of false overrun due to over-reading.	Per cent of true overrun.	Per cent of reduction of overrun by .5%.
Correct test. 25 %	800	792	80	990	.....	23.75	.....
25.5%	816	792	80	990	21.32	23.75	2.43
26 %	832	792	80	990	18.97	23.75	4.78
26.5%	848	792	80	990	16.74	23.75	7.01
27 %	864	792	80	990	14.58	23.75	9.17
27.5%	880	792	80	990	12.50	23.75	11.25

In the foregoing table we find that for every .5 per cent. over-reading, the overrun is reduced about 2.43 per cent. and grows slightly less for every .5 per cent. as the cream increases in richness of butter fat.

Continuation of table XI showing a decrease in overrun in pounds of butter made, and the amount of loss at 25c per pound, when 3,200 lbs. of 25 per cent. cream is read too high as in the preceding table.

Table XII.

Dercease in lbs. of butter per .5% over-reading of cream tests daily.	Daily loss at 25c per lb.	Loss per year of 300 days.	Loss per year when 64,000 lbs. of cream are received daily.
.5% = 20 lbs.	$ 5.00	$1,500	$ 3,000
1 % = 40 lbs.	10.00	3,000	6,000
1.5% = 60 lbs.	15.00	4,500	9,000
2 % = 80 lbs.	20.00	6,000	12,000
2.5% = 100 lbs.	25.00	7,500	15,000

The necessity of proper training for operating the Babcock test is again emphasized by the results presented in the foregoing tables. When we consider the foregoing chapter in its broadest sense it

becomes evident that more and better training is necessary for the creamery operator, as well as better laws pertaining to this phase of the dairy industry. This is necessary for the protection of those who wish to perform their work honestly amidst unscrupulous persons. Taking a Dairy School course is undoubtedly the best way of gaining the knowledge necessary for properly performing all the operations necessary for the handling of the Babcock test.

74. Main Factors Affecting the Overrun.

(a) Factors Causing an Increase in Overrun:

1. Under-reading cream or milk tests.
2. Reading tests when too cold.
3. Not whirling test bottles long enough.
4. Short weight of test samples.
5. Reducing the per cent. of fat in butter.
6. Increasing the per cent. of moisture in butter.
7. Increasing the per cent. of casein in butter.
8. Reducing losses to a minimum.
9. Giving short milk or cream weights.
10. Churning at high temperatures.
11. Working butter in wash water.
12. Washing butter with warm water.
13. Overworking butter in water when soft.

(b) Factors Causing a Decrease in Overrun:

1. Over-reading cream or milk tests.
2. Reading tests when sample is too hot.
3. Black specks and flocules in sample tested.
4. Overweight of test sample.

5. Too high per cent. of fat in butter.
6. Too dry butter.
7. Decreasing the per cent. of casein.
8. Spilling milk or cream or using a leaky churn.
9. Giving over weight in milk or cream.
10. Churning very cold cream and washing in very cold water.
11. Working hard butter at intervals instead of continuously until done.
12. Draining butter too dry and adding cold, dry salt.
13. Adding salt to cream or wash water.

(c) Factors Affecting Overrun (Market Returns) After Butter is Made:

1. Dropping small pieces of butter during packing.
2. Allowing butter to stick to churn, ladles and printers.
3. Leaky butter, losing water during handling and transit.
4. Repacking hardened butter.
5. Allowing butter to harden in churn before packing.
6. Incorrect weighing of butter when packed.

CHAPTER IX.

PRODUCING CLEAN MILK AND CREAM.

(By Mr. C. J. STEFFEN, Milwaukee, Wisconsin. President International Association of Dairy and Milk Inspectors. Chief Milk Inspector of the Health Department of the City of Milwaukee.)

Sometimes I wonder whether there is not a direct relation between excessive moisture in cheese and unclean milk. It is reasonable to expect that a cheesemaker can take the necessary time in handling all processes incident to the handling of milk and making of good cheese when the milk is good, but he cannot do so when the milk he receives is overripe, gassy, unclean or otherwise defective.

Considering such defects in milk and their detrimental effect upon the quality of cheese, it is unwise for patrons to demand that cheesemakers sign a contract pledging to make first quality or stand the loss. Such a demand is unreasonable considering that a cheesemaker has not direct control over the production of milk; but to a certain extent is forced to take the patron's milk or lose his business.

Every time I read that a cheesemaker has been prosecuted for keeping his factory unclean, I know from this that the education of the producer along lines of sanitary milk production has been delayed.

The cheesemaker is mostly to blame for open, dry, curdy, sour and mealy cheese; while the patrons are mainly to blame for various off-flavors, such as barny, gassy, weedy and to some extent high acid in cheese due to the production of improperly taken care of milk.

Mr. Rex, of the Ohio Dairy Company, Toledo, Ohio, found that only Eight Per Cent. (8%) of impurities that gain entrance to milk arising from unclean cows, stable and surroundings could be removed by straining; the other Ninety-two Per Cent. (92%) were in solution; which neither can be seen nor removed. This is what causes so much trouble for the cheesemaker. The kind and amount of fermentation present in the milk and the curd during the time of manufacturing the cheese clearly indicates the degree of cleanliness on those farms where the milk has been produced.

It is found by the results obtained from our sediment test, that the amount of sediment found in any given quantity of milk is in strict relation to the germ content and future fermentations in the milk and finally in the cheese made from such milk. Therefore, it is advised that patrons carefully watch the strainer cloth as an indication of the condition of cleanliness in their milk. In order to reduce the germ content of milk to the minimum, it is advised to use the narrow top milk pail and keep the cows and surroundings clean.

75. **What Proper Care Will Do.** Milk scoring 98.3 points perfection has been produced on a dairy

farm in a common barn scoring only 48.4 points perfection. This milk was drawn under cleanly conditions and cooled immediately to 40 degrees Fhr. and later held at 35 degrees Fhr. for six days, containing at the end of the sixth day only 150 bacteria per c. c. of milk. See Fig. 8, and 9.

Interior and Exterior of Common Barn.

Figure 7.

Fig. VII. Interior Common Barn Scoring 48.4%. Milk produced in this barn scored 98.3% perfect and was the prize winning market milk at the International Dairy Show, Milwaukee, Wis., 1912.

Figure VIII. Exterior of Common Barn Figure VII.

Figure IX.

Fig. IX. Interior of Model Barn Scoring 74.5%. The milk produced in this barn scored only 73.5% perfect or 24.8% less than the milk produced in the common barn.

Note the contrast—A model dairy barn with all necessary conveniences for the production of perfect milk, produced milk which, when scored at the same age as the milk produced in the common barn, scored 74.5 points perfect. This milk from the model barn scored 24.8 points less than that produced in the common barn, while the model barn scored 26.1 points more than the common one, where the milk scoring 98.3 points was produced. The milk produced in the model barn contained 82,000 bacteria per c. c. of milk, against 150 bacteria per c. c. of milk produced in the common barn. The difference in quality here is due to lack of proper care and cleanliness at the right time. The milk from the model barn was held in the barn for twenty minutes before cooling, while the 98.3 scoring milk, produced in the common barn was cooled at once after being drawn.

This again emphasizes the need of proper methods and care of milk during the first stages of production.

It is wise to throw away a few streams of the first milk for the reason that the first half pint contains the enormous number of 19,000 bacteria per c. c. of milk and test only 1.6% fat while the after milk contains only 4,000 bacteria per c. c. of milk.

The need of immediately removing milk from the stable and cooling at once is shown by the fact that in general practice when milk is removed from the

stable and cooled at once, it contains 3,000 bacteria as against 5,000 bacteria when this was not done.

A dairy house in which milk can properly be cooled and held is a necessary part of a dairy farm. This should receive more attention, as well as the better cleansing and caring for cows. The stables should be modern in every respect—clean, dry and well ventilated. The dairy house should be so located that the air surrounding same is pure, and it should only be used for dairy purposes.

Even though Wisconsin produces the best cheese and butter, she can produce still better cheese and butter as soon as the milk that is produced is of better quality than it has been.

CHAPTER X.

CONDITIONS AFFECTING MILK.

A. Butter Faults As Affected By Conditions On Dairy Farms.

77. **The Dairyman Plays an Important Part** in the success or failure of the local creamery. It is in a great measure in his power to make the production of fine butter possible. By neglecting to perform, in a proper manner the detail part of the work (Hunziker *) pertaining to the production of clean milk (Winslow **) he throws a heavy responsibility upon the shoulders of the creamery operator.

The insanitary conditions which still exist on some dairy farms are inexcusable and would not exist if the dairyman would only do as well as he knows how. Some of the methods used are out of harmony with modern knowledge and modern methods of dairying. Since the dairyman reads dairy literature, the use of even a small percentage of the knowledge thus gained would do away with slack and old time methods.

A Few Suggestions Regarding the Care and Handling of Milk and Cream on the Farm.

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* Hunziker, Otto F., Cornell Agr. Expt, Sta. Bul. No. 197, Dec. 1901.

** Winslow, Kenelm, Clean Milk, 1907.

Barny Taints. This peculiar taint (Rogers ***) so widely known and occurring so frequently during the winter months, has its origin mainly in impurities arising from manure and dusty feed. It may, and often does, come from stable air; from dirty cows or unclean udders during milking, from separating the milk in the stable and keeping it there over night, and from insanitary stables and barnyards.

These taints may be prevented by installing a perfect system of ventilation (King *), by keeping the cows, the stable and the barnyard clean, by keeping the separator clean (washing it after every time it is used), by separating the milk in a clean room separate from the barn and having the milk room far enough away from all stable and barnyard odors.

78. **In Case the Milk has Acquired such Taints,** the creamery man must find a remedy for it. This taint can, in a measure, be overcome by skimming a heavy cream and diluting it with about ten per cent of clean, sweet morning milk. In addition to this, add from twenty to thirty per cent of a first class starter. Now ripen the cream to about .50 per cent. aciditiy and cool at once to 48° F., and hold at this temperature for about three hours before churning. If the off-flavored cream is hand-separator cream, pasteurize it if possible, then ripen and cool the same as mentioned above. Pasteurization always improves such cream and should always be

*** Rogers, L. A., W. S., Farmers, Bul. 348, 1909.

* King, F. H., The King System of Ventilation, Seventh Ann'l. Rept., 1890.

used if possible. Add to this cream as heavy a starter as is possible without reducing the fat test below 23 per cent. Cool below churning temperature and hold at this temperature until ready to churn, which will be any time after the lapse of about two hours after cooling.

79. **Cowy Flavors.** The cause of cowy flavors in butter is not well understood. This peculiar taint may be the combined result of several minor causes. The general impression is that it is due to insufficient cooling of the milk before the cover is put on the can. When milk is put warm into cans, the cover put on and the milk allowed to cool slowly, the fine flavor of the milk is spoiled. This will affect the flavor of butter, and for this reason the creamery operator should insist upon his patrons taking proper care of the milk. Care and cleanliness, and having a good system of cooling the milk at the farm, may do away with this odor in the milk.

80. **Musty Flavor in Milk and Cream.** This flavor is due to the placing of milk in cans immediately after milking, closing the cans and allowing the milk to cool slowly without stirring. When milk has received this treatment and the weather is warm when it is sent to the factory, the heat from the outside causes the development of a peculiar musty flavor. The more slowly the milk cools, after having been placed warm in the cans, the more pronounced will be the musty flavor. This is especially noticeable when milk is carried for some distance in an open wagon.

The dairyman should cool the milk or cream well, stirring it at the same time before placing the

cover on the can. If the air is exceptionally cool and pure, leave the cover off, placing only a finely meshed screen over the can during the short time the milk may be held at the farm.

The creamery operator should use the same method in separating the milk and handling the cream as is indicated in the treatment of milk and cream for barny flavors. Pasteurization of the cream at the creamery is recommended, as this flavor will pass off to a great extent during heating and cooling.

THE CARE OF MILK AT MILKING.

81. **The Small Top Milk Pail is Recommended.** In Figure 6 will be seen three types of milk pails. The small top milk pail is recommended as the best for general purposes. Beneath the milk pails will be seen a list of figures showing that the wide open pail is not so good as the narrow top pail.

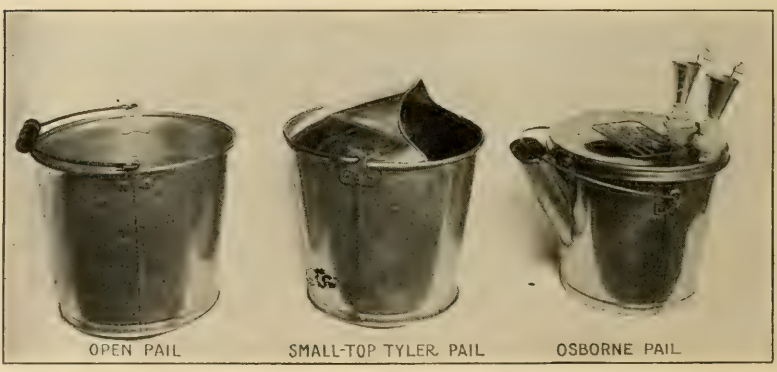

Figure 10. Different Kinds of Milk Pails.

Circular 41-1912, Wis. Exp. Sta.

Table I. Bacteria in Milk When Open and Small Top Pails Were Uused.

Patron	Open pail	Small-top pail
	Bacteria per c. c.	Bacteria per c. c.
44	70,000	8,000
102	177,000	49,000
38	64,000	32,000
22	2,550,000	185,000
21	296,000	9,000
81	800,000	106,000
86	300,000	95,000
31	217,000	37,000
39	36,000	4,000
151	146,000	49,000
37	7,300,000	23,000
101	450,000	39,000
Average	1,052.000	50,500

B. Cheesemakers Troubles and Helps.

82. **Main Cause of Pinholes in Cheese.** For a number of years a cheesemaker at a certain factory had more or less trouble with pinholes in his cheese, and the trouble was finally traced to the milk delivered by one patron.

This farmer's cows were well cleaned and cared for, the barn was cleaned and whitewashed and had lime sprinkled on the floors and the milk was taken from the barn and cooled in a tank of cold water. The cheesemaker, however, felt confident that the trouble was caused by the milk from this particular

herd and it so happened that he had an opportunity to discover the cause. Wishing for a change of occupation one summer, he went to work for this farmer and by careful observation he located the trouble. One of the cows being a heavy milker, leaked milk whenever she lay down to rest before being milked. This milk soaked into the plank floor and some of it naturally wet the cow's udder. The moist udder gathered up particles of dust in which was fermented milk and during milking some of these particles of dust got into the milk. The germs multiplied so fast that from this one cow's milk the whole batch of milk at the factory was contaminated and this caused much trouble and financial losses.

Dairymen should ask their cheesemaker to tell them how to make a curd test in order that they may know more of the condition of each cow's milk. Or the dairyman may keep a set of half-pint bottles into which he can put samples of each cow's milk and have the cheesemeker make the test.

Dairymen should remember that it takes very little barn yard or stable dust in milk to make it impossible for the cheesemaker to make good cheese from.

83. **Poor Setting of Milk.** For a number of years the operator of a certain cheese factory had trouble with poor setting of milk. Sometimes the setting of the whole vat was poor and at other times the milk in one end of the vat did not set well. It was discovered that a portion of the milk in a separate vessel when placed upon the cheese press set perfectly, while that in the vat refused to do so. This

poor setting of the milk caused a heavy loss of butter fat and a general poor condition of the cheese.

It was found upon investigation that the tin of the vat was very thin and would spring and vibrate very easily when the jacket was not filled with water. The stirring of the rennet into milk caused the vat sides to vibrate and these vibrations continued during the first stages of the coagulation of the milk. This naturally prevented perfect coagulation and produced a loose setting of the milk.

After a wooden jacket had been placed around the inside vat, the set was normal and there was no further trouble of that kind.

The floor in a cheese factory should be solid in order that walking on it does not cause the vat to vibrate.

The inner cheese vat should always have a jecket to hold the inside vat in place whenever the jacket space cannot be filled with water. This will guard against vibrations caused either by jars or from the milk moving by stirring in the rennet and color. When those safeguards are provided, normal milk will coagulate nicely unless stirred too long.

84. **Handling Milk for Cheese Making.** When we speak of stirring milk during cooling, we consider that the milk is in large cans and not in small cans. When a large canful of milk is to be cooled in ordinary well water occasional stirring is necessary in order to cool the milk quickly. While when milk as it comes from the cows is placed in a small shot-gun can in a tank of well water, it does not need stirring, but does need changing of the water in the tank. The longer it takes to cool milk, and

the more stirring that is required during the cooling, the greater are the chances for contamination, and the more trouble with pinhole, gassy and off-flavored cheese.

Therefore, it is advisable to get some small cans for cooling milk. Procure enough cans for one milking and when the milk is cooled it can be poured into larger cans and again set in a tank filled with cold water. It is advisable to set the morning milking into cold water as quickly as the milk is strained, so that the natural warmth will leave the milk before it is delivered to the cheese factory.

This cooling is a simple matter and can easily be done. When dairymen do not take good care of their milk, they should not blame the cheesemaker when the cheese is not first-class. Milk that will make good cheese can be produced on any farm by any one with ordinary intelligence and with the most simple and common arrangement if the detail work is looked after at the right time, and in the right way.

85. **Things to Remember.**

Keep your cow stables clean, warm and well ventilated; the air as free as possible from all odors and dust.

Keep your cows clean; wipe their udders with a clean damp cloth before each milking.

Milking should be done quickly and quietly as well as in a cleanly manner.

Milk should be separated at once after milking before it gets too cold. The cream from it should be cooled before being added to previously separated cold cream. Never mix warm and cold cream; cool it first.

Milk not to be separated must be cooled at once after milking, stirring frequently while cooling with the cover slightly lifted until cold; then put cover on tight and keep cold until delivered.

Clean your separator immediately after each separation, and rinse with warm water before again running milk through.

Silage must not be fed at milking time; nor should it be kept in the feeding alley between feedings, as the odor from it will contaminate the milk and spoil its keeping quality.

Remember that cream testing between 30 to 45 per cent butter fat, brings you more money than a cream with less butter fat, because better and more butter can be made from it than from thin cream.

Cream cans should be protected from the heat of the sun either by a covered wagon or with a wet blanket. Cream should be delivered frequently and in a sweet condition.

Do not allow your cows to drink water from swamps, stagnant pools, barn yards or dirty water at any time. This will contaminate the milk, spoil the flavor of the butter made from it and render milk unfit for making fine cheese.

You can depend to a certainty that when you give your creamery man clean and sweet milk or clean and sweet, rich cream, he will make from it a fine flavored butter, or a richly flavored, high-priced cheese. Are you doing this?

When you fail to do this, your milk or cream should be graded into first and second grade, and you should not be paid full market price for badly cared for milk or cream.

When your butter buyer complains about the quality of your butter, do not blame the buttermaker unless you have done your part in delivering a good quality of milk or cream. Butter buyers will pay you what your butter is worth.

Do not permit cows to wade in sloughs.

Do not wet the fingers in the milk, nor milk with the hands dripping wet.

Do not feed hay or any dusty feed just before milking.

Do not use pails or cans having open seams.

Have all the seams soldered full in order to prevent anything lodging in cracks.

Use good tin pails and cans. Old and rusty utensils should never be used.

CHAPTER XI.

WHEY SEPARATION AT CHEESE FACTORIES.

(By G. H. BENKENDORF, U. W. Dairy School, Madison, Wis.)

We find that the losses of the fat in the whey vary with the kind of cheese manufactured. Where the so-called American cheese is made the losses in the whey approximate close to .3 of one per cent during the entire year. At certain seasons of the year, in June for instance, the loss may be rather low, while at other times the loss may be so high as .4 to .5 of one per cent. Some investigators have found the average loss in the whey during the entire season as high as .36 of one per cent.

An observation made in Sheboygan county by careful investigators showed that the drippings from the milled curd of a 5000 pound vat of milk amounted to 58 pounds testing 11.0 per cent fat. This no doubt was an exceptional case, but to get from the same amount of curd 40 pounds of drippings testing 8.0 per cent fat, is not unusual.

A friend of mine in Manitowoc county reported that during June he was able to recover 2.52 lbs. fat per 1000 pounds of milk; during December 3.94 lbs.; during the entire season the average received was 2.7 per 1000 lbs. of milk or .3 of one per cent fat in

the whey. This young man made these observations in a factory operating on the "pound for 10" system and it was to his interest to keep the losses down as much as possible. Our observations at the Dairy School corroborate these figures as being very conservative and fair.

86. **Much Fat Lost In Swiss Factories.** Those of you acquainted with the manufacture of Swiss cheese appreciate the enormous amount of fat lost in the whey where Swiss cheese is made. The high temperature employed, the fine cutting, and the rough treatment that the curd receives necessarily cause great losses of fat in the whey. Such whey tests .7 to .8 of one per cent and even up to one per cent, or in other words from 20 to 30 per cent fat delivered to a Swiss cheese factory goes into the whey and is lost unless an effort is made to recover the same.

Conservative estimates on the amount of cheese made in Wisconsin during the past season place the amount at over 160,000,000 pounds. This, as you know, is about half of the total amount of cheese made in the United States. Assuming that it took 10 pounds of milk to make one pound of cheese, we have the enormous amount of 1,600,000,000 pounds milk used in the process of manufacture. Again, assuming 90 pounds of whey as a by-product per 100 pounds of milk used, we are safe in estimating that the total whey amounted to 1,440,000,000 pounds. Now using the very conservative figure of .3 of one per cent fat lost we get 4,320,000 pounds of fat which could have been recovered. Personally I believe it amounted to over 5,000,000 pounds on ac-

count of the great Swiss cheese industry in this state and the high loss of fat in the whey produced from this type of cheese.

87. **Recovery Not As Difficult As Formerly Thought.** A good whey separator is now regarded as part of the equipment of an up-to-date factory. American cheesemakers and foreign cheesemakers testify to the profitableness of using them. Cheesemakers in American factories who have kept accurate data will agree that by careful work they can recover about three pounds of fat per 1000 pounds of whey on the average during the entire season, providing of course that a good whey separator is used. This whey fat in the shape of whey cream finds a very ready market in Wisconsin when it is properly cared for.

The care of whey cream offers no unusual difficulty; it should test from 45 to 50 per cent fat; it should be cooled immediately and should be delivered at least every other day. Such cream will bring the highest market price. A friend of mine near Spring Green receives 2 cents above Elgin for such cream during the hottest months of the year. Of course if a cheesemaker skims a thin cream, does not cool it properly and delivers it only twice a week, he can not expect a good price. Such cream acquires a whey flavor which is very objectionable and makes it impossible to manufacture first class butter from the cream.

It may be argued by some patrons that whey which has been separated has no feeding value and is not worth hauling home. Such patrons, however, are badly mistaken, for the food value of the small

amount of fat removed from the whey can easily be replaced by adding a pound of cornmeal to each 100 pounds of whey. The value of whey as a food lies chiefly in its albumen and its milk sugar content and not in the small amount of fat which it contains. While it is true that the fat it contains has some feeding value, we must remember that butter fat is worth from 500 to 700 dollars a ton and hence is too high priced to feed to hogs profitably.

88. **Use The Exhaust Steam To Pasteurize With.** While making arrangements to separate the whey many cheesemakers use the exhaust steam to pasteurize the same. This calls for little additional expense and certainly is very commendable. Pasteurization will not only tend to prevent the spreading of tuberculosis among the farm animals in the neighborhood, but the whey will get back to the patrons sweet, which they are sure to appreciate. The cheesemaker also is benefited because the labor of cleaning the whey tank becomes a pleasure rather than an irksome task.

Cheesemakers who have tried separating and pasteurizing the whey report that the patrons invariably like such whey a great deal better than the whey which has not been heated and separated. These makers claim that they get a better grade of milk following the introduction of these methods on account of the patrons not taking home the sour whey in the milk cans. The advantage alone is sufficient to pay for the trouble of separating and pasteurizing the whey.

Let us briefly look at the gross proceeds derived from the sale of whey cream and the cost of operat-

ing a separator. As stated previously the average amount that may be recovered in the whey at an American cheese factory will approximate very close to 2.7 per 1,000 lbs. of milk, which for a factory receiving 5,000 pounds of milk would be about 13.5 pounds of fat per day. This cream if properly cared for and delivered frequently will sell for a good price. I have data showing that the average price received by one cheesemaker from May 1 to December 1, 1912, was 30 cents per pound fat. He received two cents above Elgin, but had to pay the transportation charges, which amounted to ½ to ⅔ cents per pound fat.

89. **Calculations Involved.** On the basis of 28 cents, or Elgin, 13.5 pounds of fat would be worth 3.78 cents or 76 cents per 1000 pounds of milk. In the case of a Swiss cheese factory the amount would be so much greater that one wonders why there should be the least hesitancy in installing a separator to recover the fat lost.

There are two very important reasons why the hand skimming method is a bad practice: First, the method is very wasteful, particularly where "cold skimming" is practiced. Professor Farrington some eight years ago obtained data showing that .3 per cent fat is left in the whey after skimming, which, as was shown, is the average amount left in the whey at American cheese factories. In other words, one out of every three pounds of fat in the whey is lost by this method.

The second objection to "cold hand skimming" is the fact that the cream is of poor grade, it will test low and the acidity is so great that salable but-

ter cannot be made from it, hence the cream will not bring the price it should.

Where "hot skimming" is practiced the results are somewhat better, but there is considerable extra labor involved. The cream is sweet, but very thin. No doubt this method is to be preferred to the "cold" method, but neither the hot nor the cold methods can begin to equal the good results obtained by a modern whey separator which will deliver a cream testing 45.0 to 50.0 per cent fat—a point which must not be overlooked if the best results are desired.

90. **Cost Of Equipment.** The cost of installing a good separator with complete outfit depends greatly on the equipment of the factory. As a rule $450 to $500 will fix a factory up very nicely. This will not, however, supply the engine and the boiler. Steam turbine separators appear to be popular on account of requiring less room, ease of operating, etc.

As to the fuel required to separate, let me refer to an investigation made in Sheboygan County where whey butter was made. (I obtained the following data from Cir. 161, B. A. I., Department of Agriculture.) The coal was carefully weighed and it was estimated that the cost of the fuel used to separate the whey and to make the butter amounted to 1½ cents per pound of butter. A steam engine was used at this factory. Assuming that it costs the same to separate one pound of fat, we would have in a 5,000 lb. factory, 13.5 pounds fat (the whey fat recovered per day) times 1½ cents, or close to 20 cents for the cost of the fuel. At the rate of $5.00

per ton this would mean 80 pounds of coal per day, which I think is a very liberal estimate of the amount of coal which would be used. This is at the rate of four cents per 1,000 pounds of milk. It may be possible to reduce this by using a gasoline engine, many cheese factories being already equipped with them.

The question may be raised as to the depreciation of the plant and the interest on the investment of $500.00. I think we can safely assume the following:

Interest on investment, $500 @ 6%	$30.00
Depreciation, 10%	50.00
Oil	5.00
Repairs	15.00
Odds and ends such as insurance, etc.	5.00
Total for one year	$105.00

Where a season's run extends for seven months, we would have $105.00 divided by 7, which would give us $15.00 per month, or 50 cents per day, or 10 cents per 1,000 pounds of milk. I do not think that anyone would question these figures as being too low to cover depreciation, interest in investment, etc.

91. **Division Of Profits.** The question now arises, what share of the gross proceeds from the sale of the cream shall go to the cheesemaker? What part shall go to the patron? And here lies the obstruction that is preventing to a great extent the rapid introduction of the whey separator into our factories. I do not see why there should be any dif-

ficulty whatever regarding the matter. Before installing the machinery to do this work it is well to have a clear and definite understanding with your patrons.

I note that in many factories one half of the gross receipts goes to the patron and one half to the maker. In some factories the makers allow the patrons three or four cents extra per 100 pounds of milk, this amount being about one-half the gross proceeds.

I have given this matter considerable thought and believe that the following method is fair and just to all concerned: That the patrons purchase and install the separator without expense to the factory man, except such labor as would be required to put it in place (arrangements to this effect can probably be made with any supply house); the patrons' proceeds of the first cream check received to pay for the installation of the equipment; when paid for the equipment of this part of the cheese factory to belong to the patrons, the cheesemaker to receive as his share, 25 cents per 1,000 pounds of milk received at the factory; the cheesemaker to pay for his fuel, oil, and keep the machine in repair. In a 5,000 pound factory he would receive $1.25 per day for his work and the expenses connected with it. The cost of fuel, oil, and repairs ought not to exceed 25 cents per day, leaving him $1.00 for his additional labor, which I believe to be a fair compensation.

Where 8,000 pounds of milk is received the cheesemaker's part would be $2.00. It would always be an easy matter to compute the cheesemaker's

share at the end of the month. If it should be impossible at any time for the cheesemaker to separate the whey it would only take a few minutes to make an adjustment. The patrons would also know just how much they received each month from the sale of whey cream.

Charging A Set Price For Making.

Again some argue that it would be better to charge one-fourth cents per pound for making, which would net the cheesemaker about the same per 1000 pounds of milk, but offer several objections. First, in case the whey is not separated it would be somewhat more complicated to calculate the amount due the maker. Second, in case of competition there would be a tendency to commence to underbid and drift back to the same price for making that was paid before the separator was installed. I believe the proceeds from separating the whey and the charges for making cheese should be kept separate, as they represent two lines of work. In case the cheesemaker has to put in the equipment I feel that he should be allowed ten cents more per 1,000 pounds of milk to compensate for the depreciation and interest on the investment.

On the basis suggested we would have the division as follows, in case 70 cents were the gross receipts for the whey fat per 1,000 pounds of milk.

Cheesemaker	25c
Owner of equipment	10c
Patron	35c
	70c

I favor the patrons' owning the equipment for separating whey, because within a short time they will have the machinery paid for and then they will receive one cent extra per 100 pounds of milk delivered. If for any reason the market price of fat goes down the cheesemaker will receive the same amount of money, and it is right that he should, for the amount of work and expense remain the same.

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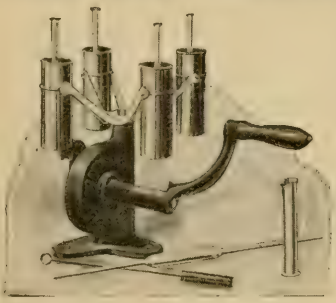

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